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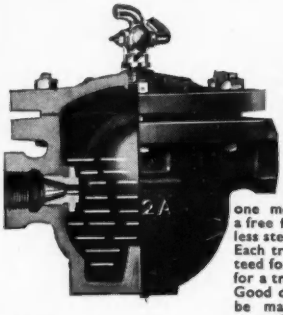

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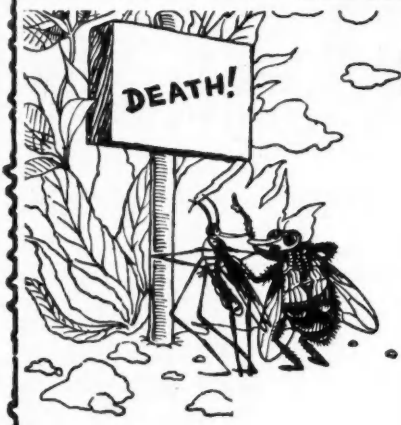

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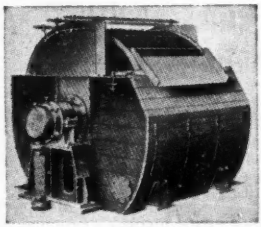

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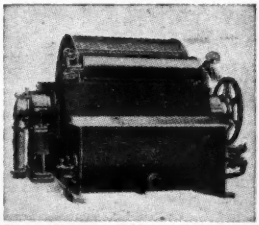

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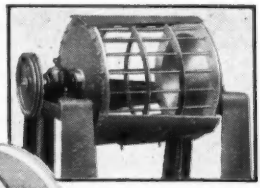

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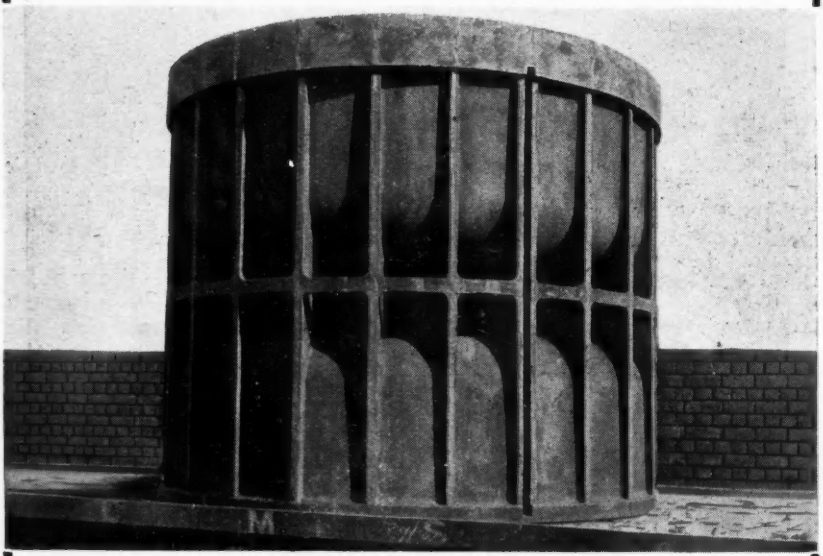

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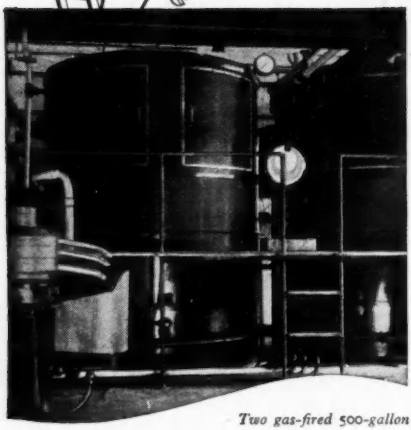

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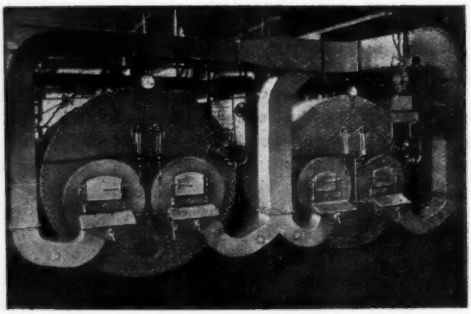

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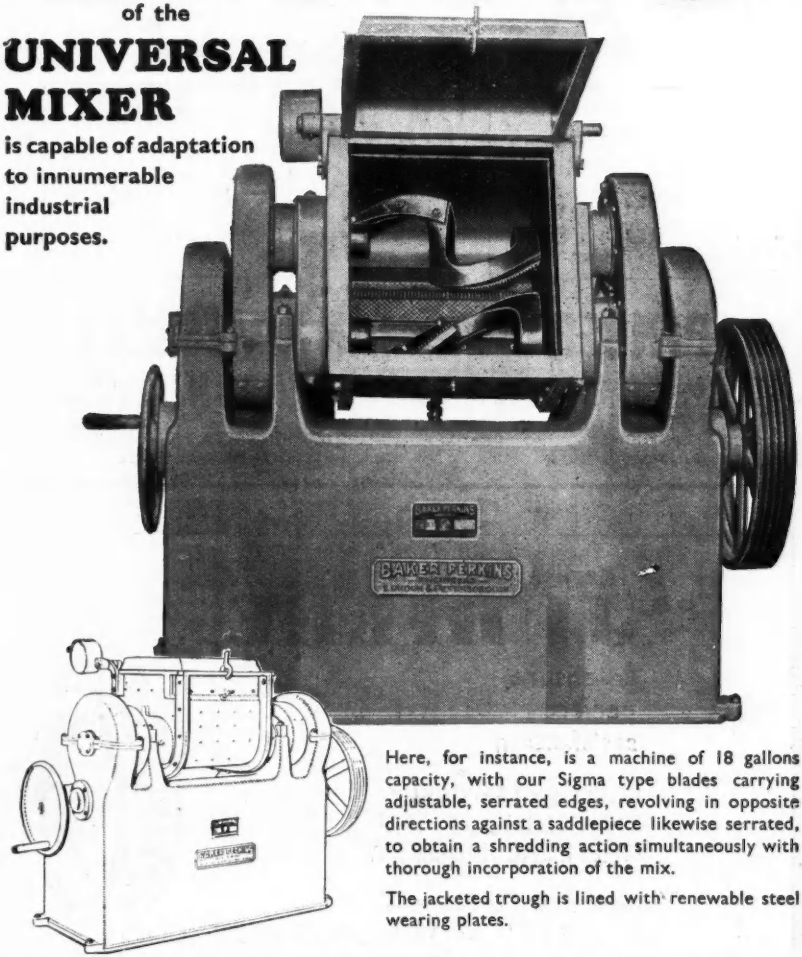

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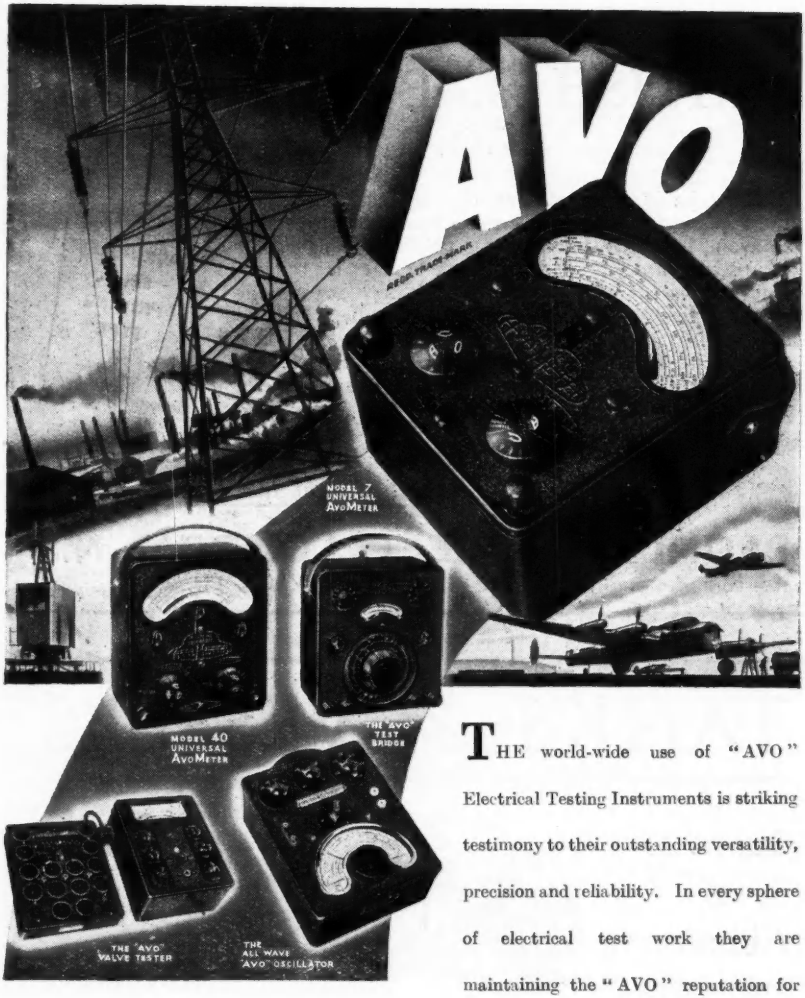

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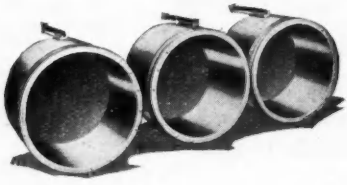

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4 January 1947

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Scientific Information

THAT too much is published to permit of any individual keeping himself up to date is an old complaint. Did not the writer of Ecclesiastes, an eminently practical man, put his finger on the trouble more than 2000 years ago? "Of the making of many books there is no end;" he said, "and much study is a weariness of the flesh." We are bound to say how much we agree with him, and so must every research worker, every busy man who tries to keep abreast of technical and scientific information. There is so much to do within the short waking hours of the 24. There must be time set aside for eating, for relaxation, for social intercourse, for exercise, and other needs of the human race. Of the hours that are left we have to take a large proportion for our daily work; it is too often only by stealing hours that should be spent in more healthy ways that we can read even that small proportion of the world's output that must be read if we are to keep up with the pace of our own little world. And yet, how necessary it is that we should do so! A memorandum recently published by Dr. B. J. A. Bard has put the need for so doing so well that we propose to quote a passage from what he has written:

"The objectives of those engaged in pure scientific research are the creation of new and the consolidation of existing knowledge, but so far as industry is concerned, knowledge to be of value must be applied. Knowledge gained by scientific research may appear to be remote from existing industrial practice, or far in advance of the requirements of the time; it may on the other hand be obviously of direct or immediate practical value to industry. Frequently intelligence and ingenuity are required to detect the application which may turn out to be unexpected and unrelated to the objective or field of the initial research. It is, therefore, of great importance that scientists present their results as a balanced picture to include all the relevant information and reasoning lucidly expressed so as to be capable of being followed by the instructed practical man in industry. Industry itself provides the most important means whereby the benefits of science are brought to the community; its development and prosperity require a constant striving to improve the quality and variety of its products, to increase output, to reduce costs, and to improve working conditions. The attainment of any of these is progress, and is dependent on the technical staff, who must be in possession of the new knowledge on which the advance is based."

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That is an admirable statement, which contains many things that are worth the careful consideration of all scientific men. Not the least important is the demand that scientists shall " present their results as a balanced picture . . . . capable of being followed by the practical man in industry." All too often scientific men, and perhaps the younger the man the more prone he is to the fault, insists on clothing his experimental data with abstruse padding and in jargon that is not only unnecessary but is also unintelligible to the works man. We do not doubt that a scientific paper presented to a body of scientists in the same field will be understood if it is written in the professional jargon of the subject. But the scientist must recognise that by so doing he rules out for himself recognition of the value of his work by those who could apply it if they only understood it. We have lately attended many scientific meetings at which papers were presented to a mixed audience of practical and scientific men. A paper written intelligently and intelligibly was found always to awaken good discussion and much interest. But the audience yawned and walked out when the author used what he deemed in his ignorance to be scientific language. But it must not be forgotten that, in Dr. Bard's words, industry provides the most important means whereby the benefits of science are brought to the community. The first and most important step in the dissemination of scientific information is therefore that new knowledge shall be presented to the practical man in a way that enables him to understand it.

Presentation, however, is not all. Knowledge must be digested as well as disseminated. When new ideas are presented they appear frequently to be complex, and to consist of a vast mass of experimental results only understandable by an expert. But on close examination it is usually found that some basic principle emerges that embraces all the results, and that thereby is evolved a new understanding of the facts. Until the practical man has secured this understanding, the results mean nothing to him. Much can also be done in the way of presentation.

When all has been done in the way of good presentation, however, one basic problem still remains and that is to see that the information published on any particular subject throughout the world is made available to those who can use it. The sum total of published information is very large and continues to grow apace. Almost all fundamental research results are published in one or another of the many scientific journals that exist in every civilised country of the world and in a number of different languages. Applied research is published in a still wider stream, embracing trade papers, patents, technical journals, the transactions of technical bodies and so forth. How is this mass of information to be brought to the notice of those by whom it can be used? Although it is claimed that it can be done by abstraction, we have doubts as to the efficacy of that method.

The method used is to make an abstract of the original paper—a very difficult task, and very poorly paid—which is supposed to show the reader what the paper is all about. Then the reader, having seen the abstract is expected to decide for himself whether the original paper should be read. This method, though better than nothing, cannot overcome the personal equation. Not all abstractors will take the same view of any particular paper, and something essential can easily be missed. But even if this handicap is overcome, a still worse one remains. It is contained in Dr. Bard's note that " frequently intelligence and ingenuity are required to detect the application which may turn out to be unexpected. . . . " One individual reading a paper will see that application; another will not. There is nothing for it but to insist that every paper dealing with a subject in which we are interested shall be read. But of course there is not nearly time enough for that. The pace of scientific publication is beginning to defeat the very object of scientific research, *i.e.*, the dissemination of knowledge. It would seem that we have reached the position when the workers in large firms must be divided into the operators and the thinkers. There must be those who operate the processes, those who design, build and repair the plant. But alongside them there must also be those whose task it is to do nothing but to read the literature that is published and to disseminate it in readable form to their colleagues on the practical side. That firms are awakening to the necessity of employing men and women especially for this latter job is a step in the right direction, for we have the authority of Dr. Bard that " it may fairly be claimed that an ample and well-regulated circulation of information is very necessary to technical progress in industry."

NOTES AND COMMENTS

WORLD SUPPLY OF TIN

TIN, like most metals, is still scarce, but there are grounds for assuming that by 1949 output will be at least equal to demand, so it may be that those responsible for allocation could, if they chose, safely exercise a degree of generosity in the coming year. That, at all events, is the plea of the Tin Producers' Association in the December issue of its publication *Tin*. The world stock position, it is argued, is sufficiently satisfactory to permit of some easing of the current shortage. The estimate of the International Tin Research and Development Council is that the present world stock, including consumers' stock, amounts to 140,000 tons, which is 80,000 tons more than what was regarded as adequate before the war. Not all of this stock is available at once for consumption; it includes a certain quantity of tin still in ore at the smelter, and the mining industry is doubtful whether Malayan production for this year will achieve the "target" of 12,300 tons. Nevertheless, development is proceeding favourably; and a steady increase in production during 1947-8 is expected. At the recent International Tin Conference it was estimated that world mine production would total 94,000 tons in 1946, rising to 142,000 tons in 1947 and to more than 200,000 tons in 1949. In view of these potential factors, *Tin* submits that the proposed release of 137,000 tons of tin to the world's consumers in 1947 is not sufficiently liberal, arguing that, though the demand at present exceeds production, indications are that output will have overtaken demand by 1949, so that there are only two years in which release from stock would be necessary to meet manufacturers' requirements. "There is no doubt," declares *Tin*, "that tin will not be in the scarce metals class for very much longer and Government agencies might well afford to be generous."

COAL FOR INDUSTRY

IN a spirited letter to *The Times* last week, Sir Clive Bailleu, president of the Federation of British Industries, dealt with the suggestion in recent reports about coal shortage at factories that some criticism should be levelled against managements for failure to draw the attention of the Ministry of Fuel to their stock position. This, he asserted, is nonsense because for years all consumers of 100 tons or more a year have been completing a form once a week, giving particulars of their stocks and current deliveries. He went on to point out something that chemical manufacturers know all too well—that in many instances goods are spoiled if they cool or solidify, or if they stand uncompleted during a period of shut-down, in all of which cases factory managers act rightly in refusing to operate the factory without reasonable stocks. After warning the Government that it would cause shutdowns if it plans to meet the fall in coal deliveries by cutting into allocations for productive industry, Sir Clive added: "There is a very grave risk of our hard-won gains in industrial recovery being liquidated." In a subsequent reply to Sir Clive's comments, the senior Press Officer of the Ministry of Fuel admitted that the Ministry is always aware of the stock position and pointed out that what it has asked industries to do is to report at once when deliveries fall dangerously short for several weeks in succession so that, if practicable, alternative transport arrangements can be made for their supplies. He recalled that at the Fuel Conference in London on October 9 the Minister stated: "Making every allowance for possible increases in production . . . we run a very grave danger of breakdown in winter." The problem, he contended, was the old one of cutting our coat according to our cloth.

PULVERISED FUEL

WAYS and means of making the most efficient and economic use of fuel are becoming of increasing importance and it is not inappropriate to draw attention to the Conference on Pulverised Fuel which is to be held in Harrogate under the auspices of the Institute of Fuel on June 3, 1947. More than 50 papers will be contributed from the electricity supply industry, water-tube boiler makers, the Fuel Research Station, the British Coal Utilisation Research Association, the National Coal Board, the British Refractories Research Association and from other branches of British industry concerned with the manufacture and use of pulverised fuel-fired plant. Contributions are also expected from South Africa, Australia, the

U.S.A., France, Holland, and Germany. The papers will not be read at the conference, as it is felt this would leave insufficient time for the discussion of the points raised. Instead, the papers are to be published in a book which will be sent four weeks before the opening session to all who take up membership of the conference. This book will contain, in addition to the papers, indexes to authors and subjects, and the programme for each session. Each programme will set out the points to be discussed at that session with a cross-index to the comments of the authors upon them, and to facilitate the following-up of these references, a bookmark with a line scale will be provided so that a reference to a particular line in any paper can be found at once. Each session will be opened by a rapporteur, who will survey the matters to be discussed and summarise the statements made and facts given relative to them in the papers. The conference sessions will then be devoted almost wholly to discussion. Reports of the discussion, with the rapporteurs' contribution, will appear as a second volume to be issued to all members of the conference at an early date. Membership of the conference will be open to anyone interested in pulverised fuel. The full programme is not yet complete, but the Pulverised Fuel Conference Committee has opened a list of persons interested (apart from members of the Institute) to whom full particulars will be sent as soon as they are available. Requests for names to be added to this list should be sent to the Pulverised Fuel Conference Committee, The Institute of Fuel, 18 Devonshire Street, London, W.1.

THE CHEMICAL KIPPER

THE lowly kipper, pride of the seaside landlady's breakfast board, has the distinction, unusual even for the magnificently majestic whale, of having four letters written about it to *The Times*. The correspondence was brought into being by a letter which welcomed the re-appearance of the kipper in the fish shops, but which sadly noted the deterioration from the high pre-war kipper standard. The writer mentioned that all the kippers have a "dead" taste, due probably to their being anything but fresh when kippered. Another kipperite wrote saying that people are apparently unaware of the tragedy that has overwhelmed the fish " that was the morning glory of the breakfast table." Formerly, he said, they were plump, picked herring, caught, gutted and hung for the night in the smoke of peat and oak chips. Now, they are dyed and dry, a reddish colour replacing the soft smoked amber of the happy past. These letters brought the public relations officer of the Herring Industry Board into the ring. He admitted that the Board knew kippers are not as they were. But he pointed out that in the annual report of the Herring Industry Board presented to the Ministers on July last year, it was stated that the Board considered that kippering methods require overhaul. They urged that the trade should be encouraged to re-establish its plants in keeping with modern ideas, with the object of producing more economically a kipper of a much more regular standard of quality than is at present produced. No mention was made by the public relations officer, however, of the relative merits of smoking and dyeing; what we might refer to as the old-fashioned or natural method as against the synthetic. Although we should perhaps, by virtue of our calling, prefer the chemically dyed fish, we must confess that our baser instincts still call for the plump, smoked kipper.

Chemical Age Year Book

Subscribers to THE CHEMICAL AGE will by now have received, and, we hope, welcomed their copy of THE CHEMICAL AGE YEAR BOOK for 1947. Thanks to some relaxation of the Paper Control, the year book has, apart from the diary, some 355 pages—over 60 more than in last year's edition. Among the features which had to be dropped from the austerity war-time productions, but which have now been revived, are the "List of Chemical and Metallurgical Journals," " Commercial Uses of Industrial Chemicals," " Capacity of Storage Tanks," and a number of physico-chemical tables as well as postal information. There is the usual extensive "Bibliography for the Chemical Industry," " Who's Who in the Chemical Industry," " Analysis of Audited Accounts," and information on raw materials controls, British research associations, and chemical and allied organisations. A comprehensive " Buyers' Guide," giving the names and addresses of the principal suppliers of plant, equipment and chemicals, and an index to more than 220 advertisers in the year book, some of whose advertisements appear in colour, add to the usefulness of the present production.

LATEST TRENDS IN POWDER METALLURGY

by W. G. CASS

THERE has been a remarkable revival of interest in metal powders during and since the war, as evidenced by the large number of articles thereon which have appeared, mainly in the engineering and allied technical press, and evidently evoked by the increasing realisation of the many valuable properties and general versatile nature of these powders. Most of these articles—*see* short bibliography at end—have rightly been of an eminently practical nature, mainly in the form of brief summaries of methods of manufacture, and principal properties and applications of interest to engineers. But to the chemist, interest in metal, or rather metalliferous, powders probably goes somewhat deeper and wider. The underlying principles indeed cover a fairly wide field in physical chemistry. This is at once apparent even on a cursory glance through any good and up-to-date book on the subject, such as that of Dr. W. D. Jones; and possibly still more obvious on looking through the rather formidable array of papers read at the 1941 Conference on Powder Metallurgy held at the Massachusetts Institute of Technology, and published in book form by the American Society for Metals in 1943 under the editorship of E. John Wulff.

The patent field too, no less than the journal literature, has been further extended by numerous additions, and a brief survey of some of these latest additions will be given here in the hope that at least a few new ideas have emerged; although, as with most patent surveys nowadays, one finds the thin and emaciated type tend to outnumber the more robust.

Historical Background

Reference has been made to a revival of interest, indicating that the subject is by no means new and in fact it dates back to the ancient Egyptians. Taking a rather long jump from then to the sixteenth century we find that Agricola in the glossary of his famous *Re de Metallica* (1556) describes the production of powdered zinc as a by-product of the lead industry. Berzelius produced zinc powder in 1824, but many years before that date Wollaston—of the well-known firm of Johnson, Matthey & Co.—had accomplished his great life work, which he kept secret till the end, namely, the production of platinum, rhodium, and other metallic powders. And it is a rather amazing fact that many of the principles and their applications which he so well and interestingly describes are quite valid to-day, though nearly 150 years old. This recalls the similar case, though not quite so long-dated, of the Verneuil process for production of synthetic sapphires and spinel from powdered alumina, as recently described by Rooksby of the G.E.C. Research Laboratories. This, though nearly 50 years old, is still used to-day almost in its original form.

Recent Developments

It is not known exactly how long metal powders have been in use for paints and coatings, but probably for half a century at least: the use of tungsten powder for production of fine filament wire for electric lamps dates back nearly as far. Some of the more recent developments of great importance have been in the electrical field, such as contacts, accumulator electrodes, etc. But by far the greatest and most valuable advances have been in engineering, e.g., sintered carbide tools, porous bearings, and a host of other things that could only be produced by powder metallurgy. This powder technique has also played a significant part in chemical industry, as in the production of specially resistant alloys for chemical plant, manufacture of porous filters, diaphragms, etc., and more particularly in catalysis.

In a paper read before the Electrodepositors Technical Society, G. H. S. Price (G.E.C. Research Laboratories) says that these methods made possible the production of parts (a) for which there is no alternative method; (b) with specific properties which can only be obtained by powder metallurgy; and (c) in which this technique offers advantages over other methods. It appears that (a) and (b) are the same thing said in different ways; but without quibbling too much about this one may say that, more specifically, it is possible to produce articles having unique properties, such as controlled porosity, unobtainable otherwise; tools can be made from metals which are difficult to melt, and from mixtures of metals and non-metals; it can be used for metals which do not alloy, and applied to metals with widely separated melting points or of differing densities; and in the production of many parts, simple or complicated, it often obviates the need for machining or other finishing. It has been said indeed that the whole field of metal alloys may in time be completely revolutionised by powder methods, and already a number of valuable alloys and bi-metal or tri-metal compacts have been prepared in this way. The possibility also of combining metal with non-metal constituents has proved

invaluable and offers further wide possibilities.

Chemical, electrolytic, mechanical and miscellaneous methods are used. These methods are elaborated in a classification given at the 1941 Conference in U.S.A. in four groups:

1. Mechanical and physical—machining, milling, shotting, granulating, atomising, condensing, evaporation (in spheroidal condition).

2. Chemical—deposition from gas (the well-known carbonyl method), reducing, e.g., direct from ore, precipitation, dissolution.

3. Electrical—Electrolytic, sputtering.

4. Coatings—sherardising, calorising, chromising, siliconising, titanium surfacing.

Price, *loc. cit.* adopts another classification.

Thermal Decomposition

Any powdered metal may be produced by thermal decomposition of its carbonyl, but the method has been mainly confined to iron and nickel, and was largely developed in Germany by the I. G. Farben, as described in their numerous English patents (including the use of these powders in various ways) *e.g.*, Nos. 262938, 269677, 281963, 284087, 311141, 322039, 317998, 324028, 327955, 330018, 332052, 349587, 353671, 361164, etc. The carbonyl is prepared from finely divided iron and carbon monoxide under pressure and a temperature between 100° and 200°C.; or from roasted pyrites reduced in hydrogen and CO at 550°C. Carbonyl decomposition takes place between 150° and 400°C. and the form of product may be varied by varying conditions of deposition. Alloy powders may be obtained by joint decomposition of mixed carbonyls, e.g., of iron, nickel, cobalt, tungsten, etc. (E.P. 367996, 423823).

Another chemical method is that of reduction which must, of course, be done at temperatures below the melting point of the metal. Oxides are usually the starting material, but other compounds may be used; and the reducing agent as a rule is hydrogen. This method is largely used for powder production, and offers certain advantages such as considerable control over particle size, shape and distribution by altering the various factors involved, namely, nature and size of compound, temperature, time, and composition—and sometimes moisture content—of reducing gas. Oxides, too, are generally brittle and easily comminuted. Tungsten, molybdenum and copper powders are still largely produced by the reduction method. Reduction of mixtures from solutions of isomorphous salts is a simple way of obtaining a wide range of alloy powders. See, *e.g.*, Eng. Pat. 431526.

In a recent patent by Minerals & Metals Corporation, New York, E.P. 573539 (addition to 557868) finely divided ore is reduced in two stages or zones, the second being of higher temperature but below the fritting or agglomerating point. There are numerous other similar patents, and this, of course, is a large field in extractive metallurgy dating back a long time.

Several other methods including precipitation from solution, e.g., tin from stannic chloride, etc., are described in standard works on the subject. Precipitated copper, iron and nickel powders may be prepared from solutions of their salts by the action of aluminium powder and an activating agent such as very dilute mercuric chloride, hydrochloric acid, or alkaline chlorides. Zinc powder suitable for sintering is obtained by direct distillation and condensation. A fairly recent and novel method is that of inter-crystalline corrosion of metal or alloy scrap with an agent such as sulphuric acid under special conditions as to heat treatment, etc. E.P. No. 555983 of Sandvikens Jernwerks A/B.

In view of the many different methods of obtaining metal powders and of the wide range of variations and control of the different factors, their physical and other characteristics can vary widely, and the need has long been felt for some sort of standardisation and specification in this important department of metallurgical chemistry. Some attention has been already given to this in the U.S.A., and no doubt it is not being overlooked in this country, especially now that the range and variety of applications of this technique in engineering, the electrical, and chemical industries are increasing so rapidly.

Size of Powder Grains

Apart from chemical properties, the most important characteristic of a powder is the particle size or particle grain size; and a valuable contribution in this matter contained in a recently published paper (*J. Res. Nat. Bureau of Stand*, 1946, *36*, 469-78) is summarised later. It deals with the size grading of diamond powders, but is applicable also to other powders. Other important characteristics, briefly dealt with later, include loading weight, flow factor, working density, cohesive ability, oxide content, purity, and especially porosity when this is a leading consideration.

Subject to a great many variations in practice the working up of metal powders into solid compacts and more or less finished articles is almost wholly summed up in the one word sintering—under suitable conditions of temperature, pressure, vacuum, reducing agents or atmospheres, etc.

The term sintering is not exactly the most satisfactory or definite that could perhaps be chosen, and right at the commencement of his book Dr. Jones has taken some trouble in an attempt to clarify the position and the nomenclature of metal powders and

their compaction. He says it is unfortunate that the common synonymity of weld, frit, and sinter may be due to mental association of welding with high temperatures or molten substances. The primary forces involved in a welding operation, he says, do not depend on temperature, and certainly no condition of fusion is necessary; and further, this mental association or misconception postulates the intervention of a liquid or gaseous phase in any chemical interaction between two solid substances. He also says that cold welding may be unfamiliar, but there are abundant examples; that although iron can be welded without difficulty at 1200°C. there is no reason to believe that the surface forces which permit welding at this temperature are less in value at 20°C.; that cohesion between two metal surfaces is due to residual forces which lie on the surface; that the degree of cohesion is largely dependent on plasticity which in turn depends on temperature; that it is necessary to make a very rigid distinction between the sintering forces and those conditions which facilitate or obstruct range of action (p. 55); and finally that the actual forces which effect sintering are the normal effective cohesive forces within the metal; they are the forces which determine its theoretical strength, and normally *decrease* with temperature (p. 55).

Inherent Cohesive Forces

Some of this is a little difficult to follow at first sight, especially as the idea of chemical interaction has been included. It can be readily agreed that no fusion is required in sintering; but that the primary (or surface, residual, cohesive or actual) forces involved in welding or sintering—and which either "lie on the surface" or are "within the metal"—do not depend on temperature is a hard saying, when, a little later, plasticity and therefore temperature is at least a basic or determining factor As the author says, it is largely a question of degree—"the degree of cohesion is largely dependant on plasticity" (temperature).[1] While theoretically, therefore, it may be possible to separate out or "rigidly distinguish" the inherent cohesive forces, yet in practice their range of action and intensity must necessarily be conditioned by various factors. In this practical sense is it not true to say they *do* depend on temperature? It should be added that Dr. Jones consistently uses the term "frit" and not sintering where fusion is involved. In fact, sintering, by definition, does not reach the melting point stage.

Since the beginning of the present century a great deal of work has been done in connection with the compacting of metal powders under very varied conditions, including mono- and poly-metal powders with or without non-metal additions. This work up to 1936 is critically reviewed by Dr. Jones in his book, with numerous references to original work, especially the classical research of Trzebiakowski whose careful and skilful technique has hardly yet been improved upon. Generally it is concluded that, as compared with cold pressing and then sintering, the practice of hot pressing gives much better results. Following is a brief review of some of the most recent patents since about 1936, illustrating the application and methods of power metallurgy in a wide and varied field.

Hard Refractories

It is probable that chief attention has been directed towards hard refractories of the tungsten carbide type for use as cutting tools, electric contacts, valve seats and other engine parts. It is well known that in compacting carbides it is necessary to include a metal such as cobalt to act as binder, and that in the case of titanium carbide, nickel is preferred for this purpose; further, that with mixed carbides more than one kind of binder may be needed. In a patent open to public inspection but not yet published (10180/46) silver is included as well as cobalt but not necessarily or only as a binder. Tungsten, molybdenum, or titanium carbide or mixtures of two of these are ground to very fine powder in a ball mill for several hours with 0.25-15 per cent cobalt and 15-55 per cent silver, compacted under pressure with the use of a little paraffin as lubricant, and then sintered in hydrogen; either in one operation at 1250-1550°C., or first heated for an hour at about 850°, cut or dressed to final shape, and again heated and completely sintered at about 1450° until sufficient shrinkage has occurred to expel or exude some of the silver and thus eliminate porosity. Some of the cobalt is said to form an alloy of solid or liquid solution with the carbide and promotes sintering at high temperature, but the silver or silver base alloy fuses and fills voids and imparts good thermal and electrical conductivity and, it is claimed, other valuable properties. An exceptionally hard (Brinell 350-625), tough, and resistant product results.

Silver infiltration is also used in E.P. 575,929 and 575,996 together with refractory metals of the 4th, 5th, and 6th periodic groups (W, Mo, Ta, etc.) and their carbides, nitrides, and borides, in the production of linings or facings of clutches and the like in place of the previously used asbestos, sintered bronze powder, etc. Some copper powder may also be included (U.S. 2162380). The use of copper infiltration appears to be increasing in the U.S.A. (*see* page 10). In 574,076 the powder chiefly used is that of the iron group (Ni or Co), the bonding agent being Cu, Ag or Au, and the particle-coating

metal being of the platinum group; for use in electric contacts.

Other patents dealing with the use of tungsten and similar carbides are 552,851, bearings for precision instruments (includes use of thoria, etc., which has long been known in the manufacture of tungsten filament wire from powder); 555,025, forging and densifying hard bodies—sintered compact is heated to plastic state and forced into die by sudden blow; 563,796, fused carbide with or without other metal may be sprayed as powder on to mild steel or other tubes; 572,801, production of shaped articles of sintered carbides using binder of iron group (*e.g.*, cobalt) together with about 3 per cent thermosetting plastic; 573,740, seamless tubes of refractory metal, using core, *e.g.*, borosilicate or glass of lower coefficient of expansion; 579,205, refractory metal carbides for armour-piercing projectiles. In E.P. 544,192 is claimed a method of welding hard carbides on to a supporting member (sintered iron or alloy) for use as cutting tool, wherein welding is defined as union by heating but without fusion.

Vibration to Assist Compacting

The use of centrifugal or other movement or vibration is often claimed to assist compacting and avoidance of large voids or "bridges." For example, in 540,785, for manufacture of sintered hard alloy articles, the compacting mould is subjected both to centrifugal motion and also rotary motion, as also in 554,110, production of porous metal articles; 562,934, porous metal plates; 580,490, consolidating powdered metals, or cemented carbides.

The manufacture of porous bodies for use as filters, diaphragms and especially self-oiling bearings, is an important development in powder metallurgy; and involved among other things the interesting technique of particle size control (Jones, pp. 146-153). For example, in 536,653, in controlling particle size of compacts of sintered tungsten or molybdenum, or in ceramic work, a suitable organic binder, such as a solution of ethyl cellulose in toluene, is used. *See* also 554,110 noted above, and 581,700 where particular attention is paid to dimensions of mould, the width of which varies inversely with density of moulded article, or in other words it is widest where furthest remote from the punch. The aim is to secure uniform density.

On the subject of particle size control it may be well to interpose here a brief account of work on size grading of diamond powders carried out by the U.S. Bureau of Mines, as it should be applicable to metal powders. Various liquids were tried as dispersing media, and of the thirty or so materials tested gelatin solution was found to be the best. Several methods of separating the powder into size fractions are investigated and discussed. Cooke's short column elutriator was found satisfactory for determining size of large quantities of powder with little manual attention. Results of size fractioning are shown by photomicrographs, and some standard specifications are appended as a result of the work and after conference with producers and consumers. In addition to determining efficiency of various methods of separating diamond powder into size fractions, it was also essential to find the best dispersents which must be able to wet the powder particles and develop an electrical charge thereon, as determined by a small electrophoresis cell. As stated above, gelatin solution was the best, with addition of sodium carbonate to give a *p*H of 9, and a few drops of thymol to prevent fungi growth. As compared with pine oil, alcohol, and ethylene glycol, the gelatin solution is most easily obtained.

Reference has been already made to infiltration of silver into sintered metal powder compacts. Copper, gold and other metals have been named in various specifications. But particular interest centres in copper, according to recent developments in the U.S.A. by General Motors and by American Electro-Metal Corporation (Yonkers, New York). For example, the so-called cemented steels have been described by E. S. Kopecki (*Iron Age*, 1946, *157* (18), 50-4). In order to increase density of steel powder compacts the method of infiltration of a low melting metal was developed. Some applications of this method are given, including gears impregnated with copper and tungsten contact points with platinum. Higher densities and improved mechanical properties, *e.g.*, tensile strength up to 185,000 lb./in.^{2} are claimed. The products can be readily surface-treated, also electroplated without infiltration of the plating solution, and jointing is easy. Steel parts bonded with copper can be carburised, nitrided, or cyanided by removal of copper to the desired depth in a chromic acid bath. They are also readily machinable.

Porous Steel Skeleton

In another article on the same subject in which the Sinteel G of American Electro-Metal Corporation is more particularly described (*Materials and Methods*, 1946, *23*, 987-991) infiltration of a porous steel skeleton is mentioned, and it is further added that Gebauer in 1916 and Baumhauer in 1922 were already experimenting with the infiltration idea. It is understood that the U.S. Navy sought to utilise the cemented steel project, but the work was not completed, apparently through difficulty in producing a suitably coated powder. Presumably, the particles are coated before compacting and infiltration. Special apparatus is described in which the molten copper alloy in refrac-

tory containers is moved in such manner that it works upwards by capillary action into the pores of the steel compact. Copper base alloy was used instead of pure copper owing to the affinity of this latter for iron.

In U.S. P. No. 2401221 of General Motors Corporation, of which the application date was July 24, 1943, and the published date June 25, 1946, powdered iron is briquetted under pressure, sintered for half an hour under non-oxidising conditions at just over 2000° F., cooled, and either immersed in molten copper containing 3-6 per cent iron, or sprayed with copper powder containing 4-8 per cent iron powder. It is claimed that this copper-impregnated iron is free from pits and has a higher tensile strength and elongation than material impregnated by other methods.

Engine Parts

Manufacturers of motor cars and engines are naturally interested in metal powders which are now largely used for important engine parts subjected to serious wear and strain, such as valves, piston rings, brakes, clutches, bearings, etc. *See*, for example, the numerous patents of the British Piston Ring Co., Ltd. : 538,227, mixture of soft and hard iron powders, with or without other metals, together with 1-3 per cent powdered graphite; 551,232, annular blanks are formed from powdered metal; these are split across during pressing and expanded; 558,408, compacts are prepared on formers and sintered in non-oxidising or neutral atmosphere. *See* also 571,128, 571,139, 575,478, 581,700, 538,679 552,532, 560,483, etc.

Electrical parts are another important field. Reference has been already made to 536,653 (G.E.C.) involving particle size control. Others in this field are B.T.H. patents Nos. 557,847, 571,881 (use of plasticising medium such as glycerin), 572,099 (extruded tubing); G.E.C. 567,127; Standard Telephones & Cables, 570,346 and 570,385 (making selenium elements); Igranic Electrical Co., Ltd., 571,228 (electrical contacts); Telephone Mfg. Co., 574,583 (metallic alloys, *e.g.*, iron-nickel); M.O. Valve Co., Ltd., 580,744 (wire manufacture; use of refractory oxide such as alumina, and wet hydrogen).

Machine Tools

In that important class of machine tools known as abrasives, grinding wheels, etc., for surface finishing, truing, and so forth, metal powders are finding increasing use and range. In E.P. 556,023, of the Carborundum Co., a mixture of metal powder (copper, tin, and iron or lead) is used to bond abrasive grains such as those of diamond; 572,945, of F. Calvert and another, manufacture of abrasive tools; 575,588, L. M. van Moppes & Son, improvements in diamond and like tools, using iron powder and bronze either powdered or massive; 578,200, American Optical Co., improvements in abrading tools, using crushed diamonds, sapphires, corundum or the like, held in a sintered mixture of copper and chromium; 580,963, E. A. Pokorny, diamond tools for lapping and grinding, using manganese oxide as bond either alone or with other binders, is claimed as an improvement in powder metallurgical methods. *See* also the numerous patents of the Norton Co.

Dr. W. D. Jones has several patents in connection with small porous parts for electrical connections, for prevention of ice formation on aircraft, etc., *e.g.*, E.P. 566,276, 567,970, 568,294, 568,786, etc. Sparking plugs are comprised under 578,956; welding material under 571,317, 573,336-8, 573,595, 573,598; and there still remains a rather large miscellaneous class, 539,516, 543,495, 554,364, 555,983, 558,390, 558,810, 560,986, 563,970, 564,905, 565,520, 566,484, 567,566, 568,795, 569,718, 570,166, 571,927, 573,077, 573,539, 575,998, 577,249, 577,714, 577,798, 580,414.

Vacuum Working

No reference has so far been made to vacuum working, though this was by no means an uncommon practice years ago, *e.g.*, in E.P. 274,283, of Metropolitan-Vickers Electrical Co., Ltd., wherein an improved method of sintering refractory metals is claimed. Occluded air or other gas is removed from the pressed powder by slowly heating first of all to about 350° C. (for zirconium) under high vacuum, and then to 800-1000° C. by induction heating or passing through a current. And in E.P. 376,299, of Fansteel Products Co., Inc., for manufacture of hard alloys for cutting tools, a mixture of refractory metals—tantalum, niobium, molybdenum, tungsten, together with boron or carbon and an auxiliary metal of the iron group—is pressed and then heated under vacuum to remove gaseous impurities. A later method is included in one of the many Murex (welding material) patents, as in E.P. 571,317, wherein a vacuum may be employed as an alternative to a non-oxidising atmosphere.

Throughout the literature a large number of outstanding questions, problems and uncertainties to be cleared up by further research are indicated; and this largely adds to and sustains interest in the subject. Powder metallurgy is still subject to certain limitations, some of which may be removed or become more remote by this extended research, the scope of which may form the subject of a further article. Meantime it is perhaps salutary and timely to be reminded about these limitations in a practical way as compared with other techniques; and this

has been ably and effectively done by H. Chase.[2]

(To be continued)

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Fuel Saving

Hints for Plant Operators

NOW that winter is approaching its peak, the Government's appeal for the utmost economy in the use of all forms of fuel becomes all the more urgent, and in this connection the following hints for plant operators, contained in the current issue of *Fuel Efficiency News*, should be of special value:

(1) Be particularly careful at this time of the year to exclude all cold draughts from the plant.

(2) Protect solid fuel as much as possible from the ill effects of bad weather before use.

(3) Periodically check the temperature and CO_2 content of flue gases—do not rely blindly on the use of instruments, which may be giving faulty readings. Watch for short-circuiting.

(4) Examine plant and settings carefully for leakage in of excess air.

(5) Make certain the plant is internally clean, remembering that soot and dust are insulators.

(6) Examine ashes for complete combustion and recover all worthwhile combustible material.

(7) Correct control of draught and dampers. This will materially aid complete combustion.

(8) Repair faulty lagging and protect any unlagged parts. Steam and water leaks should also receive attention.

(9) Be sure that plant records are being logged correctly and that any evidence of unusual or inefficient operation shown is given immediate attention.

(10) Where water treatment is practised, check on the results. Avoid wasteful blowing down.

Immediate savings can also be made in gas and electricity:

(1) Be ruthless in cutting out idle running.

(2) Plan the work so that furnaces and such like are run only when fully loaded; avoid lighting them for odd jobs; don't put more into use than are absolutely essential.

(3) Furnace doors should not be left open a moment too long—be adamant on this point.

(4) Check the lagging of ovens, tanks and other plant; repair at once broken or faulty lagging.

(5) Insist that every gas burner must be turned off when not actually needed for work.

(6) Moving parts which work freely stand a better chance of being handled properly; see that all controls can be adjusted easily.

(7) Mark the air shutters on natural draught furnaces and the control valves on furnaces using high pressure air so that the plant can be worked at the most economical settings.

(8) Insist that lids of liquor tanks and salt baths are kept on as much as possible.

(9) See that every electric appliance is switched off when not in use (read the riot act to all offenders).

(10) If you have biggish transformers, see that they are never left on to supply negligible load.

The salt deposits of Austria, which are large and important, were the subject of a recent report by the United States Senior Economic Analyst in Vienna. In 1938, reserves were estimated at more than 200,000,000 tons, and additional deposits underlying those already being exploited have been disclosed. Associated with the salt are gypsum and anhydrite. Average monthly production of salt in 1937 was 6660 metric tons, which was increased under the Nazi régime by 25 per cent and, since VE-Day, has reached a figure higher than that in peace-time.

MODERN DEVELOPMENTS IN ACETYLENE CHEMISTRY

by GUY G. S. DUTTON, B.A., A.R.I.C.

IN view of the increasing attention being paid to acetylene as a starting material for various processes ranging from the manufacture of synthetic rubber to the development of sex hormones, it is interesting to note that details have recently been published (CIOS Report No. XXX—83) of a plant in Germany where acetylene is produced by electro-thermal cracking of hydrocarbons.

The "Chemische Werke," at Huls, is supposed to be the first plant to produce acetylene by an arc process involving the cracking of low molecular weight hydrocarbons. By this process 200 tons a day of 97 per cent acetylene are produced, the majority of which is used for the preparation of butadiene and a small proportion for making acetaldehyde, acetic acid, acetic anhydride and acetone.

It was intended to run the plant on refinery gases which consisted mainly of C_2 and C_3 hydrocarbons. Owing to bomb damage this supply was curtailed and natural gas had to be used instead. The plant consists of 17 pairs of high-temperature arc converters in which the cracking is carried out. The converters are arranged in pairs in order that one of the pair may be shut down for repairs or overhaul without affecting the supply of acetylene. Owing to difficulties further along the production lines, and to shortage of electric power, not more than ten pairs of converters have been worked at once. The power for each arc is derived from a mercury vapour rectifier system designed to give a current of 1000 amperes at 7000 volts. The gas supply consists of a mixture of 50 per cent natural gas with 50 per cent recycle gas which is fed to each converter at the rate of 2800 m^3/hour at 1.8 to 1.5 atmospheres pressure. It is found that the maximum conversion is obtained when the power factor is kept between 0.70 and 0.75, and that the central arc tube of the converter has a life of about 250 hours, the temperature of the arc being 1600°C.

Yield from Natural Gas

The exit gas from the converter is immediately quenched with water and then has the following composition by volume: acetylene 13, hydrogen 52, ethylene 1, saturated hydrocarbons (mostly methane) 25, carbon monoxide 2, and nitrogen 7 per cent. In addition to this, approximately 3 per cent of the hydrocarbon input is converted to carbon black. These figures show that when operating on natural gas a yield of 50 per cent is to be expected, and it is stated that with refining gases an even better yield is obtained although no figures were given.

Purification

As the plant was erected in a hurry during wartime it was not possible to test each individual stage on the pilot plant scale before assembly and consequently much of the purifying apparatus would be unnecessary under ordinary conditions, although it served some useful purpose as, for instance, in the separation of HCN which was scarce and required for the production of acrylonitrile.

The first step is to remove the carbon black which is done in three stages, according to the size of the particles. The various grades are then packed and used in the manufacture of rubber goods. At this point the stream of gas from all the converters converge in a common header and the subsequent purification is concerned therefore with only one stream of gas. The gas is next cooled to 25°C. with the minimum quantity of water in order to prevent too great a loss of the HCN present. The gas is then washed with oil to remove benzene and other hydrocarbons. The bottoms from this scrubber are heated to 70°C. and stripped under 600 mm. vacuum with CO obtained from a later stage in the purification process. The overhead from this process is used as a fuel. The gas is finally washed with water to remove HCN and then passed through iron oxide towers to remove sulphur.

The gas is now sufficiently pure for the extraction of the acetylene, and the first stage is to compress the gas stream, after dilution with recovery gas, to 18 atmospheres in four stages. This gas is then scrubbed with water to remove acetylene and the off-gas, which contains less than 0.1 per cent acetylene, has the following composition by volume: methane 25, hydrogen 55, ethylene 1, carbon monoxide 4, nitrogen 10, ethane and higher 4, and oxygen 1 per cent. The acetylene is then expanded through a turbine and flashed in stages to give a 96 per cent acetylene, the main impurities being higher acetylenes which must be removed before the aldehyde stage.

Two methods of removing the higher acetylenes are used; one of these methods is expensive but recovers the higher members whereas the second method is cheaper

and simpler but makes no attempt to isolate them. This second method consists simply of scrubbing the gas with a light oil and yields a 97 per cent acetylene suitable for use in the acetaldehyde plant. Since it has been found that dilution of the higher acetylenes with methanol greatly reduces the risk of explosion, all parts of the plant are fitted with methanol flushing lines for use should an emergency arise.

Hydrogen Recovery

Reference to the composition of the off-gas from the acetylene recovery stage show that the two most important constituents are hydrogen and ethylene. The essential method for separating these and the other gases is by a process of fractional liquefaction for which a Linde type of plant is used. In these five cuts are made on the gas: hydrogen, CO-N_2, ethylene, methane, and a C_2 cut, the last two of which are combined within the apparatus and furnish the main source of re-cycle gas.

The conversion of acetylene into acetaldehyde and related compounds at the "Bunawerke" at Schkopau, is described in BIOS Final Report No. 75. For the production of acetaldehyde the reactors which are made of mild steel and lined with a hard rubber (Buna 85) are 3 ft. 3 in. in diameter for the bottom 33 ft. and widen to 6 ft. diameter for the last 6 ft. 6 in. Such a reactor should produce 40 tons of aldehyde a day. The acetylene is blown in by a water ring blower at the rate of 56,000 cu. ft./hour after admixture with steam, the supply of which is regulated to keep the reactor at 90° to 98°C. The catalyst for this conversion is maintained in the solution at the following concentration: 90 gm. of iron per litre of which 60 per cent is in the ferrous form, 1 to 2 gm. of mercury, and 30 gm. of SO_4 per litre. Where the reactor increases in diameter is a pipe which takes off the excess solution and this passes to a ferro-silicon tank where the catalyst is regenerated with nitric acid. At the same time the mercury is collected in a trap and returned to the reactor. A mixture of aldehyde, excess acetylene and steam passes out at the top of the reactor. This gas stream then passes through two condensers where it is cooled to 25°C. and where a 12 per cent aqueous solution of aldehyde collects.

The residual gas is further scrubbed with water to yield a 9 per cent aldehyde solution and this is then combined with 12 per cent solution. The 10 per cent solution of aldehyde in water is fed to the top of a tower at the bottom of which live steam is injected. Aldehyde and water vapours distil over and pass to a bubble cap column, entering one-third of the way up. Aldehyde with a little acetylene passes over and an aqueous solution of 7 per cent aldehyde, and 7 per cent crotonaldehyde leaves the bottom.

The concentrated aldehyde which still contains a small amount of acetylene is passed to the head of a still heated by means of a closed steam coil. Some acetaldehyde and acetylene pass over and are condensed, and on release of the pressure the acetylene is liberated and returned to the reactors, while pure aldehyde leaves the base. The aqueous solution containing crotonaldehyde and acetaldehyde flows into a 33-ft. high packed column one-third of the way down. Live steam is injected at the bottom giving pure acetaldehyde which passes over and leaving a 4 per cent solution of crotonaldehyde. This dilute solution then passes to the mid point of a similar column which is heated with a closed steam coil and 85 per cent crotonaldehyde distils out.

It is found that the yield of acetaldehyde from acetylene is from 95 to 96 per cent of theoretical and that the amount of crotonaldehyde is 0.2 per cent of the aldehyde produced. For this process 1.1 lb. of mercury, 6.5 lb. of ferric sulphate octahydrate, and 7 lb. of nitric acid (100 per cent) are required as make-up. One ton of aldehyde produced by this method requires 3.5 tons of steam and 20,000 cu. ft. of acetylene. In an average year 144,000 tons went to Buna and the remaining 12,000 tons were used for the production of acetic acid and anhydride.

Conversion to acetic acid is effected by passing oxygen into the aldehyde, contained in aluminium oxidisers, in 2 per cent excess, mixed with sufficient nitrogen to give an off-gas having an equal volume of each. As the aldehyde is pumped into the oxidiser a concentrated solution of manganese acetate is fed in in such a manner as to give 0.5 to 1 gm. of acetate per litre of aldehyde. Each oxidiser is fitted with cooling apparatus in order that the temperature may be maintained at 70°C. The liquid leaving the oxidisers contains 2 to 3 per cent of aldehyde which is separated and re-cycled. The solution of acetic acid flows to ferro-silicon pots which are indirectly heated by silver coils. The vapours at 0.7 atmospheres pass up packed columns from which acetic acid of 98.5 to 99 per cent purity is obtained. By this method the yield of acetic acid based on aldehyde used is 95 per cent of theoretical.

Acetic Anhydride

Much the same plant is used for producing a mixture of acetic acid and anhydride as is used for acetic acid alone. For producing the anhydride the aldehyde is diluted with twice its weight of ethyl acetate before the mixture is fed to the base of an oxidiser. The catalyst is also added at this stage and consists of a mixture of cobalt and copper acetates in the ratio of 1 to 2,

the concentration in the oxidiser being 0.5 to 1 gm. of mixed acetate per litre. The aldehyde is fed in at the rate of 1 ton per hour but in this case the reaction temperature is maintained at 40°C. For the oxidation a mixture of oxygen and nitrogen is used as before and the liquid which leaves the oxidiser consists of 4 per cent of unchanged aldehyde while the final ratio of anhydride to acid is 56 : 44. This liquid is then treated in a ferro-silicon still from the top of which passes a mixture of aldehyde and ester and this separates on cooling into two layers. These layers are then treated separately and returned to the oxidisers. From the bottom of the still runs a mixture of acid and anhydride containing the catalyst. This solution is distilled from 35 gallon pots fitted with silver steam coils, as described for acetic acid, and the sludge remaining which contains the catalyst is led off and regenerated. The mixed acid and anhydride is then distilled from a packed column where acetic acid is obtained as the distillate. From the bottom of this column is obtained a concentrate of the anhydride which is finally distilled in batches under a pressure of 1½ lb./sq. in. The first runnings, which are acetic acid, are returned to the still used for separating acid and anhydride.

By this method a ratio of 56 to 44 of anhydride : acid is produced but it has not been found possible to maintain this ratio without the addition of ester, failing which the ratio is only 20 : 80. For every 100 tons of anhydride produced, 10 tons of make-up ethyl acetate is required.

Acetone

Acetone is produced by the catalytic oxidation of acetic acid and for this process vapourisers of 450 gallons capacity are used in the first stage. The contents of these vapourisers are maintained at a constant level of 220 gallons and are fitted with a central nickel coil of 2-in. bore through which steam is circulated at a rate sufficient to vapourise 3100 lb./hr. of acetic acid. The vapourised acetic acid then passes to a preheater from which it emerges at 420°C. and passes to the catalyst chamber. This consists of three concentric steel cylinders and hot gases pass up the inner tube and the outer annulus while the catalyst mixture is packed into the inner annulus through which the vapours of the acetic acid pass. The temperature of the catalyst is maintained at 420°C. and at this temperature, with a tube length of 13 ft. 6 in., conversion is practically complete. The catalyst, which is cerium oxide deposited on pumice, is prepared by spraying a solution of cerium oxide in glacial acetic acid on to hot pumice so that a pumice carrying 12 to 15 per cent of its weight of oxide is obtained. This catalyst lasts for one month after which time it is leached with hot acetic acid and the cerium solution used for impregnating a fresh batch of pumice (1¼ lb. of cerium oxide make-up are required per ton of acetone produced). The vapours leaving the catalyst chamber are cooled by a water condenser, when aqueous acetone is obtained at the base and carbon dioxide is allowed to go to waste. Before distillation the acetone is treated with caustic soda solution in tanks of sufficient size so that the solution may remain undisturbed for six hours. This aqueous solution is then distilled when acetone passes over and water leaves the bottom of the still. The concentrated acetone is now given a second wash with caustic soda, the main reason being to remove any aldehyde, and is then refractionated when pure acetone is obtained. The waste from this still is mainly diacetone alcohol. The yield claimed for this reaction is 96 per cent of the acetic acid used.

The methods described above for the conversion of acetylene into other starting materials represent methods which are standard German practice, but in addition to these there are many other processes which have been developed for using acetylene. Much of this work is the result of experiments carried out by Water Reppe and many of these syntheses have been operated successfully on a pilot plant scale, while others are still only laboratory curiosities. Some of the more interesting of these reactions will be described in a later article.

RESISTANCE WELDING HANDBOOK

The publication of an entirely new handbook on resistance welding is announced by Philips Industrial (Philips Lamps, Ltd.).

A companion volume to "Philips Practical Welding Course" (which deals with arc welding), the handbook is intended to be of use to works directors, works managers, engineers, foremen and others whose interest in resistance welding lies in its practical application to the production job. It is in no sense a technical manual for the design and construction of resistance welding machines. Technicalities have been avoided as far as possible.

"Philips Resistance Welding Handbook" runs to 210 pages and is printed on good quality art paper. Full bound in black leather cloth, gold blocked, and measuring 8¾ by 5½ inches, it is profusely illustrated with half-tone pictures and many line drawings and diagrams. It may be obtained from the publishers—Philips Industrial (Publications Dept.), Century House, Shaftesbury Avenue, price 10s. 6d. net (11s. by post) or through any bookseller.

Hydrogen Peroxide as Propulsive Fuel

From Our New York Correspondent

ADDRESSING the power session of the annual meeting of the American Society of Mechanical Engineers at the Hotel Pennsylvania in New York City recently, Captain Logan McKee, U.S. Navy, Chief of Design Branch of the Bureau of Ships, discussed the use of hydrogen peroxide for propulsion purposes, particularly by the Germans during the war, for V-bombs, and for powering aeroplanes and submarines.

The Germans used a concentration of 80 to 85 per cent for 26 different war weapons and had it in an experimentaal stage for 40 odd others. They used it to launch V-1 bombs, to drive fuel pumps in the V-2 bombs, and to drive torpedoes, aeroplanes and submarines. Capt. McKee characterised the performance of the aeroplane as "astounding," and said that the thrust from the rocket engine corresponded to that of a 3700 h.p. conventional-type engine though it weighed about 250 lb. He described the hydrogen peroxide driven torpedoes as much superior to those of any other type in performance, and "essentially wakeless."

Higher Degree of Concentration

"Prior to and during the war, hydrogen peroxide in this country was not concentrated for commercial or military purposes at greater than 50 per cent," Capt. McKee said, "Now we can and do concentrate it commercially to a higher percentage than the Germans ever did and to a greater degree of purity." He said that some companies can supply it at 90 per cent concentration with only 5 parts per million impurities. It was sometimes used by the Germans as a monofuel or primary fuel, that is, using only the heat of dissociation of the H_2O_2 into H_2O plus O_2. It was, however, used more often as a secondary fuel, that is, all or nearly all of the free oxygen was further burned with a fuel, such as decalene, similar to diesel oil, or methyl alcohol. The reaction would, in some applications, take place all in one step by the use of a liquid catalyst and fuel combined. The mixture the Germans used was hydrazine hydrate and methyl alcohol.

For the V-1 and V-2 bombs, only the heat of dissociation was used. It was a rather expensive use of energy, but was so positive in action that its simplicity and reliability were worth the cost, Capt. McKee pointed out.

"The fuel supply of the aeroplane lasted only a very few minutes but thrust was so great that the plane could not be flown in level flight, with the engine on, for more than a few seconds, and it very quickly approached the speed of sound. It could climb to 30,000 feet in two minutes, which made it extremely valuable as an interceptor plane. A later design added a cruising jet which increased about twenty-fold the time that the engine could be kept on. Its rate of climb and speed in level flight, under cruising-jet conditions, were not much better than that of an orthodox gasoline-engined fighter plane, and its radius of action much less; but, until the fuel was exhausted, it had a tremendous reserve of power," Capt. McKee said.

In 1943, when the Germans realised that the United States anti-submarine forces had won against their type 7C submarines, Professor Walter, the foremost proponent in Germany of the use of hydrogen peroxide, was able to speed up acceptance of his submarine, the Captain said. Professor Walter had been experimenting since 1935, and before the war built and operated an 80-ton submarine powered by hydrogen peroxide. During the war he supervised the design of four school boats, the first of which went into operation in the autumn of 1943. They were followed by five operational boats. These were 380 ton surface-displacement vessels with a surface speed of 8.5 knots, and a submerged speed of 25 knots. They did not have a war patrol because there was never enough hydrogen peroxide to permit them to operate. Under construction when the war ended was a submarine of 900 tons surface displacement, 11 knots surface speed and 24 knots submerged speed. The hydrogen peroxide engine was rated at 7500 horsepower.

In conclusion, Capt. McKee stated that submarine propulsion was the ideal application for hydrogen peroxide, its value resulting from the fact that using it is a good way to obtain O_2 for combustion when operating submerged. The one big disadvantage is its cost, which is roughly a thousand times greater than fuel oil when producing power.

Holland's exports of chemical products in 1946 will, it is estimated, total some 30,000,000 guilders. Main exports are common salt, paints, essences and pharmaceutical products, which are sent to Belgium, Norway, Switzerland and to the U.K. Considerable attention is being paid to coal-tar products, especially dyestuffs, and the industry is seizing the opportunity offered by the cessation of competition from Germany. The carbide industry is also on the upgrade.

Census of Industry

Chemicals, Dyestuffs and Drugs Included

THE chemicals, dyestuffs and drugs industries are to be included in a part census of production during 1946, covering a limited number of "capital goods" industries, as a forerunner to the national census which is to be undertaken for the present year.

According to the current issue of the *Board of Trade Journal*, the statutory schedules, on which firms engaged in the industries affected will be asked to make returns, will be issued by the Census of Production Office shortly. They have been settled after consultation with each of the trades concerned.

One of the purposes of the partial census is to obtain information as to the progress of the industries to be covered. These industries have been specially selected for this purpose and include certain of the important "capital goods" industries of this country. The Government attach great importance to the collection of this information and wish to have the results of the census available as quickly as possible.

Before the first complete post-war annual census is taken in respect of all productive work during the year 1947, it is considered important to determine the best way of carrying out the recommendations made in the Nelson Report. These recommendations have been incorporated in a series of questions, the form of which was settled by the Census of Production Advisory Committee—on which there are a number of prominent industrialists—after very detailed consideration of all the difficulties likely to be encountered by manufacturers in answering them. Each kind of question will be addressed to one or more of the trades to be covered by the 1946 partial census.

Clearing Up Ambiguities

The object of this is to enable the Board of Trade to study any queries raised by firms before the form of the question is finalised, as there may be difficulties not foreseen by the Advisory Committee, and it is important to clear up any ambiguities, etc., before the questions are addressed to industry in general. The Board accordingly invite manufacturers, after they have considered the schedules, to let the Census of Production Office know of any special difficulties they may meet in preparing the information called for in the new questions.

It is recognised that 1946 was a year of transition, and that the period of reconversion from a wartime state to a peacetime condition, particularly in many sections of the capital goods industries, is still incomplete. Accordingly, comparisons of output for 1946 with outputs for other years will not give a completely satisfactory picture of the changes which have occurred in industrial production. The question of the productivity of industry has, however, become extremely important in view of the restricted labour force, and experience in studying the problems involved is necessary before it can be ascertained what are the essential figures to be collected in future.

Co-operation Essential

The purpose of the 1946 partial census can only be fully achieved with the co-operation of the firms to whom schedules are sent. Like its predecessors, the partial census is compulsory, the period allowed for completion of the returns being two months, but it will be of very material assistance if firms are able to complete the forms and return them to the Census of Production Office well within those two months.

One important change from the pre-war basis on which details of output and of materials used were collected is now being made, and this should contribute materially to the ease with which firms will be able to furnish information. In the past they have been instructed to make their return on the basis of the actual production of each item specified, or of materials and fuel purchased and used in the year of return, this practice involving an adjustment for changes in stocks for every item by both quantity and value (or cost). It has been decided to change the basis to manufacturers' *sales* figures for individual items of output and to *purchases* of materials and fuel, information regarding stocks of finished products and of materials at the beginning and end of the year being called for only in respect of a few important items for which particulars of total production in the year or total materials used in the year are regarded as essential.

The census applies to all persons carrying on an undertaking within the industries specified and any person or firm in those industries who does not receive a form within the next three weeks is asked to communicate with the Census of Production Office, Great Westminster House, Horseferry Road, London, S.W.1, when an appropriate schedule will be sent.

The staff of the Census of Production Office are anxious to be of assistance to firms in the completion of their forms, and will be prepared to help in any way possible either by correspondence, by telephone (Victoria 3811), or by personal interview.

Sensitive Carbon Monoxide Indicator*

Development by Bureau Chemists

A COLORIMETRIC indicating gel that will detect and estimate less than 1 part of carbon monoxide in 500 million parts of air, a sensitivity more than 100 times greater than that attained by former chemical indicators, has recently been announced by the National Bureau of Standards' Gas Chemistry Section. This gel will also detect 0.001 per cent by volume in less than 1 minute, and determine physiologically significant amounts (0.01 to 0.4 per cent) in approximately 1 minute at ground level. The indicator is so sensitive that it is possible to diagnose carbon monoxide poisoning by analysing exhaled air instead of taking a blood sample for the analysis. Developed to meet the war-time demand for a simple and sensitive means for determination of very small amounts of carbon monoxide in military equipment and installations, it offers promise for many peacetime applications.

Early in the war it was evident that the determination of physiologically significant amounts of carbon monoxide in aircraft, particularly at high altitudes, would assume increasing importance. This was true as well with such equipment as flame throwers, tanks, gun pits and turrets, P.T. boats, landing craft, and aircraft carriers.

Former Disadvantages

Existing methods of determining carbon monoxide possessed two decided disadvantages. First, the simple, inexpensive, and easily available methods were not sufficiently sensitive. Second, those which were sufficiently sensitive were unsuited for field use, with the exception of one expensive instrument available in limited quantities, whose operation and maintenance was generally beyond the abilities of non-technical men in the services.

During 1941, the Royal Aircraft Establishment, Farnborough, England, developed an indicator for the detection and estimation of small amounts of carbon monoxide in aircraft. As this indicator was not entirely satisfactory, the Bureau of Aeronautics, Navy Department, and later the U.S. Army Air Forces requested the National Bureau of Standards to study the R.A.E. gel, with the object of improving it or developing a suitable substitute. Starting with this material, Bureau chemists produced an indicator about four times as sensitive, more adaptable to field conditions, and truly colorimetric.

The indicating material, yellow in colour, is a silica gel impregnated with a complex silico-molybdate compound and catalysed by means of palladium in the form of the sulphate. The yellow indicator turns various shades of green and bluish green on exposure to very low concentrations of carbon monoxide. The colour response is a function of time by concentration of carbon monoxide—a direct parallel to the physiological response to this gas. For use, the indicator gel is sealed in a small glass phial about 5 in. long and the approximate diameter of a lead pencil, with protecting layers of pure silica gel in each end of the tube.

To make a test, the ends of the indicating tube are broken off and the tube inserted in an ordinary 2-oz. rubber aspirator bulb equipped with a special rate-controlling valve. The air to be tested is drawn through the tube by squeezing the bulb once and any colour that develops is compared with a set of standard colour chips. Such a test can be made by untrained personnel in about 1 minute. For use in aircraft, tables giving correction factors for altitude are provided. Complete equipment for field use can be carried in a box which fits the pocket of a field jacket.

The N.B.S. Colorimetric Carbon Monoxide Indicators were made only at the National Bureau of Standards, and altogether more than a half million were supplied for the military services of the United States, Canada, and Great Britain. Patents have been issued on the device and assigned to the Secretary of Commerce.

Among the prospective peacetime uses are examination of air in and around buses, automobiles, garages, furnaces and furnace rooms, industrial plants, and civilian transport planes, and in the diagnosis of carbon monoxide poisoning. The tubes may also be modified to serve as detectors for other reducing gases and vapours, including many organic vapours.

* From *National Bureau of Standards Technical News Bulletin* No. 354, October 1946

Argentina plans to become self-supporting in production of sulphur, and to encourage domestic industry the Government is restricting imports. Sulphur production in Argentina was started during the war; previously the country had depended on imports. Output reached 12,000 tons annually, but this is insufficient.

The problem of weed pests in compost materials is to be tackled on scientific lines through a Fellowship set up at Rhode Island State College to conduct research with granular calcium cyanamide, and possibly with other chemicals, to involve an effective and economical method of destroying such weeds.

Key Industry Duty

List of Chemicals Exempted Until June 30

THE articles specified below are exempt from Key Industry Duty until June 30, 1947. This is announced by the Treasury in an order entitled "The Safeguarding of Industries (Exemption) (No. 6) Order, 1946" (S. R. & O. 1946, No. 2168), copies of which are obtainable from H.M. Stationery Office.

Scientific instruments, the following: Fermentographs, that is to say, instruments for measuring and recording carbon dioxide evolved during dough fermentation; integrators (planimeter type).

Compounds of rare earth metals, the following: Celtium oxide; dysprosium oxide; erbium oxide; europium oxide; gadolinium oxide; holmium oxide; lutecium oxide; scandium compounds; terbium oxide; thulium oxide; ytterbium oxide.

Synthetic organic chemicals, analytical reagents, other fine chemicals and chemicals manufactured by fermentation processes, the following: acetamidosalol (acetylamido phenol salicylate); acid adipinic; R. acid carbolic; acid carbolic (synthetic); acid dipropyl-malonic; acid filicic; acid maleic; acid propionic; acid quinolinic (acid quinolcic); acid sebacic; acid succinic, but not including acid isosuccinic (acid methylmalonic).

Acyl derivatives of urea, the following: acid isobutyl allyl barbituric; acid isopropyl barbituric; iso-amyl ethyl barbituric acid; *N*-methyl ethyl phenyl malonyl urea; sodium ethyl methyl butyl barbiturate; sodium iso-amyl ethyl barbiturate; sodium propyl-methyl-carbinyl allyl barbiturate.

Alcohol amido-ethyl; alcohol capryl; alcohol dodecyl (alcohol duodecyl); alcohol isopropyl, unrefined, containing not less than 0.5 per cent. by weight of ketones; alcohol octyl, secondary normal (2-hydroxy-*n*-octane); alcohol propylene; allyl paracetaminophenol; amido-guanidine sulphate; amidopyrin (dimethyl-amidoantipyrine); amidopyrin-barbitone; R. benzo-phenol; benzo-phenol (synthetic); the following bornyl ester, namely, isobornyl thiocyanoacetate; the following butyl ester, namely, butyl methyl adipate; camphene; carbamide; caesium bromide. The following cellulose ether, namely, ethyl cellulose; cocaine, crude.

Crystals, not optically worked, weighing not less than 2.5 grams each, consisting wholly of one of the following: barium bromide; R. barium chloride; barium fluoride; barium iodide; caesium chloride; caesium iodide; calcium bromide; R. calcium chloride; R. calcium fluoride; calcium iodide; lithium bromide; lithium chloride; lithium fluoride; lithium iodide; R. magnesium oxide; potassium bromide; R. potassium chloride; potassium fluoride; potassium iodide; rubidium bromide; rubidium chloride; rubidium fluoride; rubidium iodide; sodium bromide; R. sodium chloride; sodium fluoride; sodium iodide.

Cumenol, pseudo-. The following alkyl cyclohexanol ester, namely, methyl cyclohexanol methyl adipate; dicyandiamide; didial (ethyl morphine diallyl barbiturate); *p*-di-ethoxy ethenyl diphenylamidine and its hydrochloride; diethyl amino-ethanol; diethylamine (ethylamine, di-); diphenyl; diphenyl oxide; elbon (cinnamoyl para-oxyphenyl-urea); emetine; emetine bismuth iodide; emetine hydrobromate emetine hydrochlorate.

Ethyl esters, the following: ethyl abietate; hydrogenated ethyl abietate; ethyl benzoyl-benzoate.

Eukodal; furfurol; germanium oxide. The following diglyceryl ester, namely, diglyceryl tetra-acetate; the following glycol ester, namely, glycol diabietate. Glycol ethers; guanidin carbonate; guanidin nitrate; guanidin sulphate; guanidin sulphocyanide; kryofin; lipoiodin; maleic anhydride; R. mannite (R. Mannitol); the following menthyl ester, namely, menthyl ethyl glycollate; the following mercury compound, namely, *N*-(oxy-aceto-mercuric-propyl)-ethyl-urethane; methyl amidoxybenzoate.

Methyl esters, the following: hydrogenated methyl abietate; methyl abietate; oxymethyl para-oxyphenyl benzylamine methyl sulphate.

Methyl-sulphonal (diethysulphonemethyl-ethylmethane, trional); methylene chloride. The following naphthyl ester, namely, alpha-naphthyl isothiocyanate; nickel hydroxide. The following octyl ester, namely, sodium dioctyl sulpho-succinate.

Organo-arsenic compounds, the following: copper methyl arsenate; 4-oxy-3-ethylamino-phenyl arsinic acid *N*-methyl tetrahydropyridine β-carboxylic acid methyl ester.

Oxy-acetophenone, meta-; phenetidine, ortho-phenetidyl-phenacetin and its hydrochloride; phenol (synthetic); R. phenol; phytin; piperazine (diethylene-diamine, dispermin); potassium ethylxanthogenate (potassium xanthogenate); potassium guaiacol sulphonate; R. potassium hydroxide (R. potassium caustic, R. potassium hydrate); safrol; sodium phenyl dimethyl pyrazolone amino-methane sulphonate; sulphonal; theophylline; urea; veratrine; xylol, meta-xylol, para-.

Vanadium compounds of the following kind: Vanadium-silica compounds specially prepared for use as catalysts for sulphuric acid manufacture.

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German Chemicals

Revival of Exports

A SOUTH German nitrogen plant valued at approximately £40,000 was recently sold to Norway. This is the first reported sale to a foreign buyer of a chemical works installation in the U.S. occupation zone of Germany.

On the other hand, exports of chemical products have been going on from Southern Germany for some time. In September and October salt, bauxite, soda ash, and cement were specially mentioned among raw materials shipped from the U.S. zone to foreign destinations, while chemical and pharmaceutical manufactures are prominent among semi-finished and finished products sent abroad from Southern Germany. Fairly substantial sales of dyestuffs to France were reported recently, while Austria, Holland, Denmark, Sweden, and Norway were mentioned earlier as buyers of dyestuffs and/or pharmaceutical preparations from the U.S. zone of Germany.

Need for Fertiliser Materials

Among chemical imports for the U.S. zone, fertiliser materials seem to be of the greatest importance at present. Substantial quantities of rock phosphates are to be sent to Southern Germany, as well as to other parts, and a cargo of 8500 tons of ammonium nitrate arrived as recently as the middle of November. The production of calcium cyanamide at the Trostberg plant was held up by shortage of bags, technical difficulties, and lack of coal and electric power, but improved lately. Synthetic rubber was sent into the U.S. zone from works in the British zone and French zones of Germany.

In September, the U.S. Military Government gave permission for the resumption of the production of fatty acids in its zone because the supply was not sufficient to meet the demand for the local soap ration. Formaldehyde has also been produced for several months past to meet the needs of the plastics and electrical industries. Coal-tar and coal-tar derivatives have been made available to users in the U.S. zone by imports from the British zone, but the local production at gasworks has declined as a result of a cut in gas allocations to industry.

The local potash mines in the French zone are now producing just enough potash salts to meet the needs of agriculture in the region. Of other chemical products, dyestuffs and nitrogen compounds are being sent to the Soviet zone in Eastern Germany in exchange against fertilisers from Saxony. Similarly, barter agreements have been concluded between Greater Hesse—one of the three States in the U.S. zone and the centre of an important fine chemicals and pharmaceutical industry—and provincial administrations in the Russian zone, which provide for shipments of fine chemicals and drugs to other parts of Germany. The big chemical factories in the Palatinate and Hesse also account for a major part of the chemical exports reported by the U.S. Military Government.

Efficient Adhesives

New Research Bulletin

OF considerable value to glue makers is the recently published *Forest Products Research Bulletin, No. 20—Requirements and Properties of Adhesives for Wood* (H.M. Stationery Office, 6d.), which gives information on the duties that glues have to perform and the purposes for which the various adhesives are best suited.

The fundamental requirement of an efficient adhesive is that it should maintain an adequate bond between the wood elements under the conditions of exposure that the joint has to withstand. The meaning of the terms "adequate bond" and "conditions of exposure" are examined in detail, and from them is derived a classification by which an adhesive can be put into one of four groups according to its durability, the groups being termed Weatherproof, Weather-resistant, Semi-durable, and Interior.

Adhesives for wood are classified into seven types according to their origin and the basic materials from which they are made, namely, animal glues, blood albumin, casein, sodium silicate, soya bean derivatives, starch derivatives, and synthetic resins. In a detailed description of the seven types of adhesive, each is considered under the headings of principal constituent materials, available forms, preparation, methods of use, general characteristics and durability classification. Cognisance is taken of the several varieties of glue that fall within each type, and in the particular case of the synthetic resins, the urea-formaldehyde and phenol-formaldehyde adhesives are described separately.

In the testing of adhesives, a distinction is made between experimental work and proof-testing by the methods set out in various British Standard specifications, of which a list is given of those concerned with glues for wood. It is pointed out that although some of the specification tests appear to bear little relation to their object, they have in fact been evolved from a study of practical conditions. Some information is given on composite and extended adhesives such as casein-blood albumen mixes and the urea resins to which flour has been added. A short paragraph deals with the value of toxic additions to glues of organic origin.

Electrolytic Lithium

Report on a German Method

THE lithium electrolytic cell of Degussa (Deutsche Gold- u. Silberscheide Anstalt) Rheinfelden, is described in U.S. final report No. 786 in the F.I.A.T. series, and supplements the earlier report No. 295 on lithium extraction and uses in Germany. The original plant consisted of six cells each producing 4-5 kilos lithium daily. The outside shell is of fire-brick lined with dense refractory material about 50 mm. thick, with a top of similar material and thickness. The latter has a large round central opening to accommodate the collecting head assembly; with a smaller opening in one corner for removal of chlorine gas.

The anode consists of three graphite plates 150 × 600 × 70 mm., with a circular opening in the centre of 300 mm. dia., and six round threaded graphite shafts for electrical connection. Outside connection with the power source is by means of usual copper clamps and cable. The cathode is a vertical steel shaft 50 mm. in dia. attached to a hollow cast steel head 102 mm. in dia. The shaft passes through a cast steel sleeve sealed in the bottom of the cell, while electrical contact is made with the shaft by use of a copper clamp and cable, the latter being connected with a bus-bar under the floor.

The Collecting Head

The lithium metal collecting head is suspended from a round plate covering the cell opening, and is supported by the ceramic cell cover. It is cylindrical and has a bell-shaped bottom to facilitate the collection of fine particles of molten lithium as they rise in the melt. An iron wire gauze diaphragm supported by a collar is provided at the bottom of the collecting head to separate free chlorine from lithium metal. The round plate resting on top of the cell cover and supporting the collecting head has a centre opening of 100 mm. for removal of molten lithium, and when not in use is covered by a steel plate. Other openings, similarly covered when not in use, are provided in this cover for adding the necessary lithium chloride from time to time. The diaphragm consists of 24 mesh iron wire screen in cylindrical form, suspended from the collecting head.

The electrolyte is lithium chloride (94-98 per cent LiCl, 2.5 per cent KCl, 1.5 per cent NaCl, and 0.5 per cent Fe_2O_3) fused in rafractory crucibles, cooled, solidified and crushed. The cleanest pieces of crushed salt are sorted out and used first. The part highest in iron is used later. A mixture is then prepared of 52 per cent LiCl and 48 per cent KCl (99 per cent purity) which is heated in a crucible of 500 kg. capacity to 387°C. for 6-7 hours. At this stage it is analysed to determine purity. It is then allowed to settle for at least 5 hours whereby a good part of the insoluble impurities settle at the bottom of the crucible. Such impurities as sulphates, silica, and other oxides (Ba, Ca, Fe) and also too much KCl tend to lower the yield; and too much sodium in the lithium will make it easily combustible. Strict and frequent analytical control is therefore essential.

In operating the cell, it is first of all heated with a charcoal fire, the collecting head diaphragm and cathode having first been removed. After replacing the cathode the cell is filled with molten electrolyte and the current turned on. After two hours, impurities are skimmed off and the collecting head and diaphragm replaced. Fresh supplies of lithium chloride (2.5 kg.) are added about every two hours. The lithium metal rising to the top section in the collecting head is kept under a layer of high b.p. petroleum oil, and is scooped out about every two hours with a fine wire screen ladle which retains the metal but allows the oil to pass through, except a small portion which is retained to prevent ignition during transfer to the container. Exposure of the molten lithium to air must be avoided, otherwise it ignites. Chlorine is removed through an iron pipe by absorption in a lime suspension in a stoneware tower packed with Raschig rings. This suspension requires daily renewal, as indicated by the appearance of a pink colour. The lithium collected is stored under oil, and finally remelted and cast into ingots. It usually analyses 97 per cent purity, the balance being sodium and potassium in about equal amounts.

For the production of adipontrile, a principal chemical intermediate in the manufacture of nylon, the Du Pont Co. plan to construct a new unit on the site of their electro-chemicals plant at Niagara Falls, U.S.A. Estimated to cost three million dollars, this project for producing the chemical is part of a national expansion programme for nylon.

A Swedish-Norwegian trade agreement provides for the delivery by Norway during 1947, of copper, zinc, aluminium, pig-iron, whale-oil, sulphur, pyrites, soda, and a number of chemical products, notably nitrates. Sweden will export, in addition to machinery and finished products, iron and steel, as well as certain chemicals.

Welsh Industries Fair

Chemical Exhibits

INDUSTRIAL chemicals, fertilisers, steel and metal products are among the lines featured at this year's Welsh Industries Fair, which, held in London for the first time, was opened on Wednesday at the Royal Horticultural Hall, Westminster.

The Fair has again been promoted by the National Industrial Development Council of Wales and Monmouthshire, whose chairman, Councillor George Williams, C.B.E., introduced Viscount Portal, P.C., D.S.O., M.V.O., chairman of the Great Western Railway, when the latter performed the opening ceremony. Mr. E. H. Lever, chairman of Richard Thomas & Baldwins, Ltd., proposed a vote of thanks to Lord Portal.

The fair is open to-day and again on Monday and Tuesday from 11 a.m. to 6 p.m.

Exhibitors whose stands will be of particular interest to our readers include Richard Thomas & Baldwin, Ltd. (products of steel rolling mill, together with specimens of "end" products from the company's metals); Guest, Keen & Nettlefolds, Ltd. (hot and cold rolled steel bars, grey iron castings, fireclay refractories); Sheppard & Sons, Ltd. (non-ferrous metal furnace, with ingot casting machine); South Wales Forgemasters, Ltd. (drop forgings and stampings); Tubal Cain Foundry & Engineering Works, Ltd. (iron and non-ferrous metal castings); Landore Chemical Co., Ltd. (fertilisers and insecticides); Cutrilin, Ltd. (industrial chemicals); George Cohen, Sons & Co., Ltd. (insecticides); and Mastrole Products (plastic goods).

Chemical Exports

November Figures Show Decline

THE value of United Kingdom exports in November, totalling £92,000,000, exceeded the year's previous peak figure, that for July, by £200,000 and was £1,200,000 higher than October's total.

The volume of exports in the month, as for October, is estimated at 117 per cent of the monthly average for 1938, allowing for increased prices; this compares with 120 per cent in July. November, it should be noted, however, had only 26 working days, as against 27 in October and July.

Imports in November, totalling £124,300,000 in value, were £3,000,000 less than in October, but otherwise were the highest both in value and volume since the end of the war.

Exports of chemicals, drugs, dyes and colours—grouped together in the Board of Trade returns—totalled £5,921,000 in value in November—which is lower than October's post-war record of £6,545,000, but still substantially up on the figure of £3,022,000 in November, 1945, and the monthly average of £1,856,000 during 1938.

The total included £3,394,000 in exports of chemical manufactures and products other than drugs and dyestuffs; £1,184,000, drugs, medicines and medicinal preparations; £631,492, dyes and dyestuffs and dyeing and tanning extracts.

Among the importing countries, British India was again well ahead of all others, her purchases amounting to £901,236 in value —£260,410 higher than in the same month of 1938. Australia was again second highest buyer, with £314,011—nearly double the figure for November, 1938—followed, as in October, by Germany, with £290,107.

The United Kingdom's imports of chemicals, drugs, dyes and colours during November, at £1,427,256, showed a slight drop from October's figure of £1,499,689 though still substantially heavier than the comparable figure for 1945. The United States continued as our main supplier, with goods valued at £326,274 (as compared with £384,999 in November, 1945); Spain, sending us goods to the value of £205,265, moved up to second place; while France took third place with £128,637.

B.I.F. CHEMICAL SECTION

Eighty-nine manufacturers of chemicals have applied for an aggregate of over 27,000 sq. ft. of space at the British Industries Fair to be held next May, according to the *Board of Trade Journal*. At the 1939 Fair a total of 23 exhibitors had 9723 sq. ft. of exhibiting space.

Most of the pre-war exhibitors will again be showing; a large proportion of the new exhibitors will be well-established firms exhibiting at the Fair for the first time. This important group of manufacturers will be found in a prominent position at the entrance to the Grand Hall of Olympia, where, in pre-war years, buyers have been accustomed to find them.

The chemicals section of the Fair is being organised with the assistance of the Association of British Chemical Manufacturers.

The U.S.A. plastics industry has grown from annual sales of 20,000,000 dollars in 1936 to an estimated 750,000,000 dollars last year, and leaders in the industry expect it to reach the thousand million level in two or three years. The *New York Journal of Commerce* says this tremendous expansion has been made possible largely by the full support given by producers of plastic materials to research and development.

Metallurgical Section

Published the first Saturday in the month

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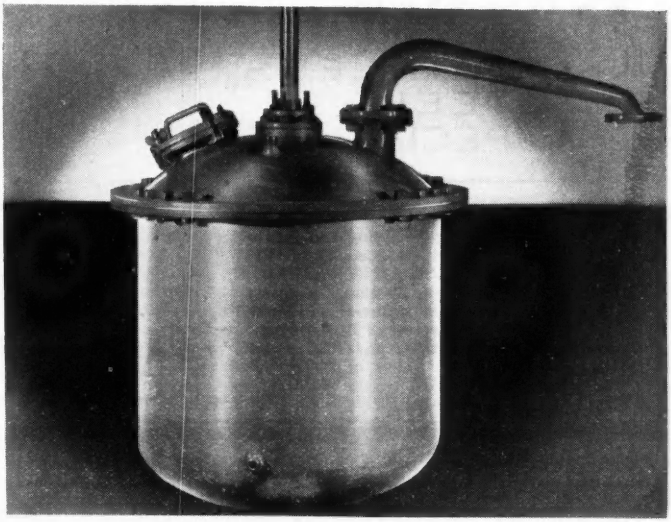

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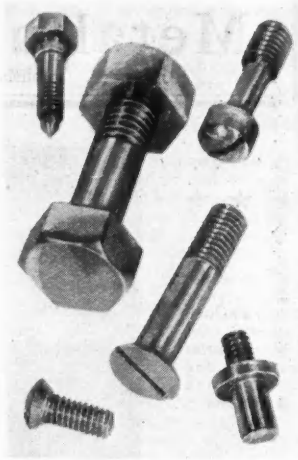

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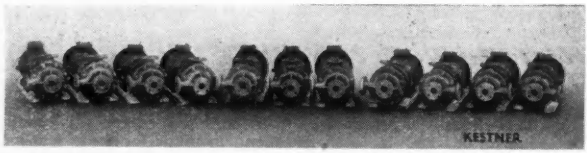

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Metallurgical Section

4 January 1947

LEAD AND ITS ALLOYS*

A REVIEW OF PROPERTIES AND USES

by BRIAN M. REAVELL, B.Sc., M.I.Chem.E., A.M.I.Mech.E.

FOR thousands of years lead has been mined, smelted and used by man for domestic and industrial purposes. In Britain the Romans made good use of our mineral resources and lead is to be found among the metals which they mined and worked. It is this so-called base metal, with which our earliest civilisation was familiar, that has enabled the chemical industry to grow up from insignificant beginnings to the enormous proportions that it occupies in the industrial world to-day. It is sometimes claimed that the true measure of a country's industrial prosperity is to be found in the weight of sulphuric acid it produces per annum. It may be in years to come that this measure of prosperity will be expressed in terms of atomic energy produced. But in either case the base metal, lead, will continue to play a vital rôle.

The lead-bearing ores are fairly well distributed over the earth's crust but little mining of lead is done in Britain to-day. The commonest ore used is galena, which is the sulphide. Many methods have been adopted for smelting and refining the ore but in principle they follow the same general procedure. The ore is melted in a coke-fired blast furnace with suitable fluxes and run off molten from the base. This produces an impure lead that has to be desilverised and refined. In the commonly used Parke's process the molten impure lead is first skimmed and then mixed with zinc. The gold and silver impurities alloy with the zinc and on cooling the whole mass it is found that the zinc alloy crystallises and solidifies first, enabling the now pure lead to be separated.

Chemical Lead: Lead required for use in the chemical industry is generally very pure and the presence of small amounts of other elements has to be studied with greater care than for iron and most other metals. The accepted standard in use to-day is B.S.S. 334. The need for working to a high degree of purity involves the manufacturer in difficult problems which can only be overcome by close control of the raw materials and rigid inspection throughout all stages of production.

It is important to appreciate the reasons for classifying chemical lead in two types A and B, as considerable misunderstanding exists over this question. In no way should type A be considered as better than type B without having regard to the purpose for which the lead is required. For example, in the construction of sulphuric acid chambers type B lead has many advantages owing to its better resistance to corrosion and better mechanical properties. On the other hand for the fabrication of awkwardly shaped parts, type A lead is frequently preferred as it is claimed that the plumber can work the sheet more easily. Also in the manufacture of nitrating towers where extremely arduous conditions of corrosion have to be met, type A lead is always used. Therefore, it is advisable to take into account all factors—corrosion resistance, creep, physical strength, etc.—before deciding on the type of lead to be used.

Commonly Used Alloys: The elements most commonly found in type B lead are copper, nickel and tellurium, which are usually added deliberately with a view to imparting specific properties to the lead. When these small quantities of other elements are added they are commonly referred to as "dilute alloys" to distinguish them from the higher alloys of lead and antimony described below. One well known "dilute alloy" is Telledium brand lead which has a tellurium addition. The type B lead is commonly produced in the form of extruded pipe or rolled sheet but neither type is widely used for casting.

For casting purposes a higher alloy is usually employed, the alloying metal being antimony. Additions of antimony improve the strength of the metal and do not seriously affect the corrosion resistance for a large number of uses. These alloys vary from 1 to 10 per cent antimony and are generally termed Regulus metals. B.S.S. 335/1928 is the accepted standard to which these alloys are produced. There are other binary alloys of lead in commercial use, *e.g.*, the various tin-lead solders, none of which exhibits any marked resistance to corrosion so that they will not be discussed here. Other useful standards covering lead products are B.S.S. 801 sheathing for cables, 602 lead

* From a lecture to the Sir John Cass Technical Institute.

pipes other than chemical, 603 lead pipes ternery alloy, 1178 sheet and strip.

The physical properties of lead are to be found in any text-book, but it is useful to remember that the metal is approximately 1½ times heavier and has approximately half the thermal conductivity of mild steel. Unfortunately, the mechanical strength cannot be expressed in such specific terms and the ultimate tensile strength is not so definite a property as it is in stable metals, such as mild steel or cast iron. Special methods of test have to be employed as the metal has a peculiar power of recovery after being stressed. For this reason it is quite essential in considering and comparing results of tensile tests to know the conditions under which the strain was applied. Some degree of standardisation has been achieved in the testing rooms of lead manufacturers, but we are still a long way from reaching any international agreement of test conditions. The figures shown in Table I serve as a comparison between various types of lead and its

TABLE I

Material	*Ultimate Tensile Strength. (Rate of strain = 0.2 inches per inch per minute.)*		*Fatigue Limit, Tons/sq. inch*
	lbs/sq. in.	Elongation	
Chemical lead Type "A"	2200	40 %	± 0.18
Chemical lead type "B" + 0.06% Cu.	2300	40 %	± 0.22
Tellurium lead	2900 (Annealed)	40 %	
Sheet	3850 (Work hardened)	25 %	
Pipe	2860	55 %	± .54
6% Antimonial lead			
Sheet	5020	29 %	
Pipe	6010	22 %	

alloys when tested at exactly the same rate of strain, namely, 0.2 in. per inch of specimen per min. Creep has been defined as the "slow stretching or expansion of the material under a steadily applied load." The figures for creep strength in lead are always very much lower than the ultimate tensile strength so that this figure must always be taken into account in design considerations. The phenomena of creep in lead is being very fully investigated in the research laboratories of a large British concern and method of testing is shown in Figs. 1 and 2. The affect of temperature on the creep strength is very pronounced and as temperature reaches 100°C. so it falls off rapidly. One advantage of tellurium lead is that the creep strength falls less rapidly at higher temperature than either type A or antimonial lead.

The grain structure of lead and its alloys has been studied for many years and the use of such methods is very helpful in finding the cause of failure in lead plant. In general the type A leads have a larger and coarser structure than type B or antimonial lead. Figs. 3 and 4 illustrate this quite clearly. While it is not a certain guide to the mechanical and creep strength of a sample, it is usual to find better resistance to creep in the refined grain than the coarse grain structure.

Chemical Properties

Resistance to chemical attack is perhaps the most outstanding feature of lead, and its enormously wide variety of uses in the chemical and allied industries is due solely to this. The motto of many a chemical engineer has been "When in doubt use lead." It is not at all a bad motto but should be enlarged by adding "and apply it properly." As we shall discuss later on, the correct design of lead plant is highly important and failures caused through corrosion are far rarer than those caused by bad design or workmanship. To deal fully with the chemical properties of lead would require more time than we have available, but a recent publication of the Lead Industries' Association which is quoted

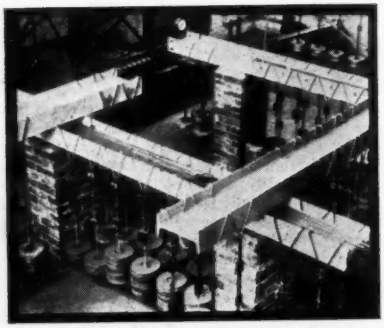

Fig. 1. View of creep testing.

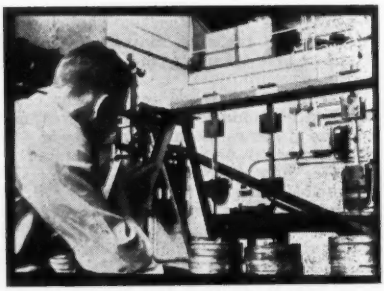

Fig. 2. Use of travelling microscope in creep testing.

herewith contains the most informative and useful information that has been published to date.

Common Applications

Pipe and Sheet: The inherent properties of lead are both an advantage and a disadvantage. An advantage that it can be worked easily by hand without mechanical presses and rolls, but a disadvantage as it quickly loses its shape and must be supported by some other material. It is available to the user in the form of pipe and sheet or for casting purposes in pigs. When constructing a pipe line in lead it is usual to buy long lengths in coil form and to uncoil the pipe on site, making the required bends and curves as required and only cutting the coil where necessary for convenience in manipulating. The cut ends can either be welded together or flanged for ease of removal in the future. Similarly, branch connections and junctions can be made *in situ* by welding or flanged ends fitted. Flanges are made either by welding on a pre-cast lead flange or by turning the end of the lead pipe over a mild steel backing flange. Pipe lines can be run out in this way by a skilled plumber quickly and even awkward bends made *in situ* with large pipes with hand tools only.

Lead sheets in a like manner are supplied in rolls and are usually available in sizes up to 8 ft. wide, 40 ft. long. For lining large plant such as acid chambers the sheet is carried to the previously erected structure and unrolled against the structure and welded to its neighbouring sheet. For small plant such as storage tanks, mixing vessels, etc., the lead sheet may be unrolled on a flat floor, marked out, cut carefully to size, and then taken to the plant, beaten into the correct shape and welded to the adjacent sheet. The lining is not complete until it has been attached securely to its frame or other means of stiffening. Inadequate fixing of the lead lining is the most frequent cause of failure especially when a plant has to be operated at changing temperatures.

Homogeneous Coating: The process of homogeneous lead coating may be described as the bonding of a layer of lead with a layer of another metal, in such a way that the bond surface is stronger than the lead itself. By means of this process it is possible to construct chemical plant and apparatus which combine the excellent corrosive resistance of lead with the mechanical strength of other metals—hence, homogeneous lead-coated steel plant is widely used in the chemical industry where corrosive conditions, high temperatures and mechanical stresses have to be contended with. The most common types of plant made with homogeneous lead-coating are digesters, mixing equipment, autoclaves, reaction vessels, etc., in which sulphuric acid is being handled at high temperatures.

The process of lead-coating cannot be applied to any metal that is incapable of being hot tinned. Fortunately, the metals commonly used in chemical plant such as mild steel, bronze and copper are readily hot tinned and are ideally suited for homogeneous lead-coating. The only important exceptions are cast iron, aluminium and stainless steel. However, as aluminium and stainless steel are only used in plant construction because of their own inherent resistance to acids, there is no need to employ them with a homogeneous lead-coating. Some electrolytic tinning processes have been used with cast iron but it is doubtful whether a homogeneous lead coating could be safely applied to cast iron after electrolytic tinning unless the service conditions were extremely light, *e.g.*, the storage of cold acid or the protection of external surfaces exposed to atmospheric corrosion.

A commonly used method of homogenous lead-coating may be explained in the following way. Lead will not by itself alloy with or bond to steel, copper, etc. Tin, however, will do so very easily—ordinary soldering of copper is simply a process of alloying of tin with the copper. Lead will alloy very readily with tin. These simple facts form the basis for the homogeneous lead-coating process. The parts to be coated with lead are first coated with tin which bonds perfectly. The lead is then coated on to the tin and it in turn bonds to the tin. The true metallurgical aspects of

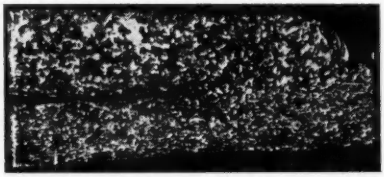

Fig. 3. Uniform small grain in lap-welded Tellurium lead.

Fig. 4. Uniform coarse grain in lap-welded chemical lead, Type A.

these operations are not quite so simple as just described, but for practical purposes the sequence of events can be regarded in this way.

Preparation of Surface for Tinning

Before the work can be tinned the surface of the metal must be perfectly clean, free from oxide deposits, scale, dirt and grease. This is particularly important when homogeneously lead-coating on steel. This preparation of the metal surface, known as pickling, is carried out by treating the surface with HCl which serves to dissolve the scale, etc., and expose absolutely clean metal. Commercial concentrated HCl is used at atmospheric temperature. For small work the whole part can be immersed in the acid, but for larger jobs this is rarely practical and acid is applied to the surface by swabbing with a mop.

Tinning of Metal Surfaces

Hot dip tinning can be employed satisfactorily but since the size and shape of work to be homogeneously lead-coated varies so widely it is not often possible. A simple method has been developed based on the use of a special tinning compound which is a mixture of pure tin and a special flux in a powder form. The tinning compound is rubbed on to the metal surface which is heated in an oxy-acetylene or oxy-hydrogen flare until the tin melts and spreads over the surface.

After tinning, lead is melted on to the tinned surface in small quantities at a time and alloyed to the tin by direct application of an oxy-acetylene or oxy-hydrogen flame. Generally the lead is used in rods or sticks somewhat like a large welding rod. In this way the whole surface of the part to be coated is built up to the required thickness of lead.

Testing Homogeneous Lead-Coating: There are two useful tests commonly used. The chisel test which is simple, rapid but destructive, and the salt test which is laborious but non-destructive. In general, the chisel test is used as a routine check by an examiner or foreman during the course of manufacture and the salt test is used at the completion of a job before acceptance by a customer.

In general, the chisel test is used as a routine check by an examiner or foreman during the course of manufacture. The surface to be tested is set up firmly and an attempt is made to remove the lead-coating by means of a cold chisel. A very sharp chisel with a 1 in. face is suitable and the operation should proceed for several inches keeping the shank of the chisel well up to ensure that the cutting face digs right down to the steel surface. If the coating is correctly bonded to the steel it will be absolutely impossible to separate or tear the lead from the steel. The chisel will simply cut the lead off and will leave behind a thin layer of lead still bonded to the steel plate. If the chisel does part and separate a layer of lead ahead of its working face even for a fraction of an inch, then the bonding is faulty.

The salt test is usually applied to tanks and vessels at the completion of a job before acceptance by a customer. The vessel is filled with a solution of salt water, about 10 per cent NaCl by weight. The salt water is left in for at least 12 hours, preferably 48 hours, then drained out completely and the vessel left to dry. When absolutely bone dry the lead surfaces are carefully examined all over. If there is a pin hole or a porous area it will show up by the presence of rust marks. These rust marks indicate that salt has penetrated to the steel surface below the lead.

Many forms of the salt test are adopted, for example, pressure and/or vacuum are sometimes applied while the vessel is full of salt water. The salt water is sometimes heated up. Where very large vessels are being tested the surface is swabbed with salt water to save the large volume of salt required to fill it. For testing small parts, complete immersion in a bath of salt water can be carried out. But these two last methods are not so searching as the first described.

Lead Castings

The casting of lead and regulus metal is carried out by two methods—in sand moulds, or in metal dies or chills. The former is used for small numbers of a given casting, and for very large castings, and the latter for repetition work especially on small parts. Melting of the lead is carried out in iron pots fired by gas, oil or coke, and normal foundry technique is used for the sand moulds and cores. One of the biggest uses of cast lead is in the construction of accumulator plates.

Finishing and Machining Lead Surfaces

Lead, being soft, can easily be cut by hand, rasps and scrapers, or machined in a lathe. The usual procedure for finishing homogeneous lead-coating is to hand-scrape the lead until a smooth surface is obtained. This is particularly desirable on curved surfaces which when left by the burner are really a series of flat surfaces. By scraping off the high points or ridges a practically perfect curved surface is quite easily obtained. The usual series of scrapers used by plumbers are suitable, *e.g.*, the pear-shaped and the triangular patterns. Very coarse rasps as used by plumbers are also used in homo-

geneous lead-coating work for finishing off inside branches, manholes, etc.

For machining no special tools or equipment are required. Any lathes or planing machines, drills, etc., as used for working steel or brass are quite suitable for working lead surfaces. The cutting speed can be higher than used for steel or brass and the tool wear is very small. Grinding of lead is not easy to perform because the grinding wheel " loads " so rapidly. After handscraping a surface it is often desired to put on a final finish for appearance's sake. For this, steel bristle brushes are used and a very pleasing dull matt finish is obtained without much work being required. A final rub over with turpentine will produce the best possible finish on the lead surface.

Pipe Lines: When above the ground these should be adequately supported at frequent intervals and if possible carried in a continuous timber trough to prevent sagging. Underground pipe lines should be laid in concrete trenches, so that no load is applied externally to the pipe. Protection against frost should not be overlooked.

Sheet Lead Lining: The variety of applications are so numerous that no more than broad generalisations can be given usefully. Bearing in mind the low creep strength of lead, special care must be taken to give all sheet linings frequent and adequate support and for hot service conditions a generous thickness of sheet is essential. Vertical surfaces need more frequent support than horizontal, and inclined surfaces something between the vertical and horizontal. It is false economy to skimp the thickness of sheet and the number of supports, as frequent renewal of a lining soon outweighs the saving in initial cost.

General Considerations

From the above description it will be seen that the flatter the surface the easier it is to coat. Similarly, sharp radiuses and corners must be avoided. The following general considerations are applicable to any plant designed for lead coating. *Never* use riveted construction that has to be homogeneously coated as it is impossible to get perfect tinning between the rivet head and the plate. *Always* have welds ground flush to the plate and dead smooth. It is, of course, important in making any design to ensure that the operator can gain access to all surfaces which have to be lead lined. The operator must be able to reach the surfaces comfortably with both hands, one holding the burner and the other the lead stick.

Tin from Siam

Arrangements for Exports

NOTES were recently exchanged between the Siamese Government, the British, and American Ministers, and the Australian Consul General in Bangkok on December 7, bringing into effect arrangements for the export of tin from Siam. These arrangements are intended to facilitate the export of tin from Siam, while at the same time making provision for the settlement of the Siamese Government's obligations to United Kingdom and Australian tin mine concessionaires whose concessions were worked by the Siamese Government during the war. They provide :

(a) For the payment by the Siamese Government within a period to be fixed of compensation on an agreed basis to United Kingdom and Australian concession holders in respect of tin lying on their properties on December 7, 1941, and mined therefrom since that date;

(b) for the establishment of a Tin Commission consisting of representatives of the United Kingdom, Australia, U.S.A., and Siam to supervise and assist the movement of tin metal and concentrates for export;

(c) that all tin metal will be shipped in accordance with Combined Tin Committee's allocations;

(d) that all tin concentrates and new production up to a date to be agreed will be purchased in equal amounts by the United States and the United Kingdom;

(e) that prices will be on a basis equivalent to those prevailing in Malaya.

A zinc refinery, costing more than $11,000,000, is to be built by American and Canadian interests near Arvida, in the Lake St. John district. The refinery will permit the Province of Quebec to produce its own sulphur and other chemicals extracted from zinc instead of importing them from the U.S., as at present.

Ready detection of uranium in low-grade complex uranium-vanadium ores is possible by a fluorescence test which, for more than two years, has been satisfactorily used by the United States Bureau of Mines on hundreds of samples of various kinds. Based on the fact that certain uranium salts fluoresce under ultra-violet light and certain solutions of uranium salts also fluoresce under requisite conditions, the Bureau process utilising short-wave ultra-violet light has provided a quick, positive method for uranium determinations and has saved much laboratory time in uranium-vanadium ore analyses.

Metal Finishing Problems

Research Association's Work

DURING the war metal finishing problems were of a specialised nature, but the return to normal production requires decorative finishes of a high order, particularly for goods to be sold overseas in competition with those from other countries. Finishing processes have, therefore, become of primary industrial importance.

Owing to the present wage level, finishes of the required standard can only be achieved economically by taking advantage of the most up-to-date methods. The Research Board of the British Non-Ferrous Metals Research Association has decided that an extension of the facilities in the Association's own laboratories to provide for researches on metal finishing would offer an economical and efficient method of tackling these problems. Before the war, the Association's interest in electrodeposition was dealt with by co-operation with the Research Department, Woolwich. The Association considers, however, that it is in a unique position to serve the metal finishing industry by undertaking in its own laboratories researches on metal finishing processes in parallel with the work on other aspects of metal quality which has been its concern for many years.

The Association is therefore embarking on a considerable extension of its laboratories to provide, among other things, facilities for a metal finishing section. This will include an experimental electro-plating shop and a special laboratory for research of a more fundamental kind The work of this section will be under the immediate supervision of Mr. E. A. Ollard, who is well known in the electro-plating industry. These new research facilities, coupled with the information and technical advisory services which the Association provides for its members, will place at the disposal of British plating firms the same strong technical backing which has already proved so valuable a support to other branches of the non-ferrous metals industry.

This extension of the Association's work has been made possible by the support which has been received from certain members in the past, but if the industry is to reap the maximum advantage from this development, the co-operation of a much wider section of the metal finishing industry must be secured. The Association wishes, therefore, to make contact with all firms interested in this project and invites any company concerned with metal finishing in any form (other than paint or lacquer) to write immediately to the Director, British Non-Ferrous Metals Research Association, Euston Street, London, N.W.1, stating the type of work with which it is concerned.

Prevention of Corrosion

Alloy Coatings on Steel

A NEW group of alloy coatings, consisting of alloys of tin with zinc in various proportions, has recently been evolved for the protection of steel from rusting.

These new corrosion-resistant coatings and their production by electro-plating are featured in the latest issue (No. 17) of *Tin and its Uses*, issued by the Tin Research Institute and obtainable from the Institute at Fraser Road, Greenford, Middlesex, or from the Battelle Memorial Institute, 505 King Avenue, Columbus, Ohio, U.S.A.

A series of full colour photographs illustrates the effects of severe corrosion tests on steel sheets coated with tin-zinc alloys in contrast with coatings of tin, zinc and cadmium. Tin-zinc coatings as thin as 0.0003 in. give notable protection, but tin coatings and zinc coatings up to six or seven times this thickness show much rusting and white corrosion products under the same tests.

Resistant to Tropical Conditions

The new tin-zinc coatings have already been used as a finish for the steel chassis of radio sets and are reported as "outstandingly resistant to tropical conditions." Other possible applications are for the protection of domestic hardware, fencing, and electric power line hardware. Tin-zinc alloys are also highly resistant to marine conditions and should find a variety of applications on sea craft. Possibly, the life even of corrugated iron sheeting may be prolonged by these new coatings.

"Is Tin Still Scarce?" is the title of the leading article in the latest *Tin and its Uses*, and the question is critically analysed. The conclusion reached is that world tin consumption will exceed current production by only a few thousand tons in the next few years, and that world stocks are now at least 100,000 tons in excess of pre-war levels. The article finds long-term prospects for tin-ore supplies to be "as well assured as are those of any other mineral."

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NEXT WEEK'S EVENTS

MONDAY, JANUARY 6

Society of Chemical Industry (London Section). Chemical Society's rooms, Burlington House, Piccadilly, London, W.1., 6.30 p.m. Mr. G. M. Bennett: "Nitration With Mixed Acids."

Oil and Colour Chemists Association (Hull Section). Royal Station Hotel, 6.30 p.m. Mr. J. D. Morgan: "P.V.C. Plastics."

TUESDAY, JANUARY 7

Institution of Chemical Engineers. Geological Society's rooms, Burlington House, Piccadilly, London, W.1., 5.30 p.m. Dr. C. C. Hall and Mr. A. H. Taylor: "Chemical Engineering Aspects of the Fischer-Tropsch Process."

Hull Chemical and Engineering Society. Church Institute, Albion Street, Hull, 7.30 p.m. Mr. E. E. Connolly: "Instrumentation in the Chemical Industry (presidential address).

WEDNESDAY, JANUARY 8

Society of Chemical Industry (Microbiological Panel of Food Group). Rooms of the Medical Society of London, 11 Chandos Street, London, W.1., 2.15 p.m. Mr. J. G. Baumgartner: "Fermentation of Vegetables for Pickle Manufacture"; Mr. T. Richards: "Bacterial Lipolysis and Rancidity in Fats"; Mr. H. H. Evers: "Curing and Fermentation of Tobacco."

Society of Chemical Industry and Royal Institute of Chemistry (Newcastle-upon-Tyne Sections, jointly with the Institute of Fuel). King's College, Newcastle-upon-Tyne, 6.30 p.m. Mr. H. E. Crossley: "The Inorganic Constituents of Coal."

Institute of Petroleum. Manson House, 26 Portland Place, London, W.1., 5.30 p.m. Mr. L. W. Leyland Cole: "Petroleum Products in Agriculture: the Role of Petroleum in Plant Protection."

THURSDAY, JANUARY 9

Chemical Society. Burlington House, Piccadilly, London, W.1., 7.30 p.m. Mr. B. C. Saunders: "Toxic fluorophosphonates and related compounds"; Mr. N. J. Cartwright and Mr. R. D. Haworth: "Some Aspects of the Oxidation and Dimerisation of Propenylphenols."

Chemical Society and Royal Institute of Chemistry (Manchester Sections). Manchester University, 7.30 p.m. Mr. J. H. Schulman: "Molecular Interaction at Oil/Water Interfaces."

Pharmaceutical Society of Great Britain. 17 Bloomsbury Square, London, W.C.1., 7 p.m. Mr. F. A. Robinson: "Recent Developments in Chromatography."

FRIDAY, JANUARY 10

Institution of Chemical Engineers (North Western Branch). College of Technology, Manchester, 3 p.m. Mr. C. E. Rowe: "Aspects of Pilot Plant Development."

Institute of Physics (Manchester and District Branch). The University, Manchester, 7 p.m. Professor D. R. Hartree: "Recent Developments of Calculating Machines in U.S.A."

German Technical Reports

Some Recent Publications

SOME of the latest technical reports from the Intelligence Committee in Germany are detailed below. Copies are obtainable from H.M. Stationery Offices at the prices stated.

BIOS 532. Visit to chemical research establishments working on combustion problems (6s.).

BIOS 756. *I.G. Ludwigshafen*: Polymeric processes (2s.).

BIOS 845. Constructional details of chlorine plant at Hoechst and Gendorf (2s. 6d.).

BIOS 889. Manufacture of nitric acid, ammonium nitrate and fertilisers at Bitterfeld, Wolfen, and Piesteritz (5s.).

BIOS 895. *Vereinigte Aluminiumwerke* (*V.A.W.*), *Luenen*: Aluminium production (6d.).

BIOS 897. *Elektrowerk Weisweiler*: Ferro-alloy production furnaces (6d.).

BIOS 898. A note on the influence of nitrogen in steel (6d.).

BIOS 904. Aluminium hydrate and alumina production in Italian factories (1s. 6d.).

BIOS 940. *Rueterswerke, A.G., Castrop-Rauxel*: Tar distillation (2s.).

FIAT 819. Metallic sodium from sodium-amalgam at Gersthofen (2s.).

FIAT 821. *Duisburger Kupferhutte*: Zinc, manganese, and other metals recovered by amalgam process (2s.).

FIAT 829. Non-ferrous metal production processes in the Hamburg district (2s. 6d.).

FIAT 830. English translation of "Sodium in Germany and the Relations between I.G. and Degussa in this field" (2s.).

FIAT 862. Polyvinyl chloride production at Burghausen and Ludwigshafen (2s. 6d.).

Personal Notes

SIR ARTHUR P. M. FLEMING has been appointed a director of British Industrial Plastics, Ltd.

DR. F. L. ALLEN has been appointed to the headship of the Department of Science of the West Ham Municipal College.

MR. F. HARTLEY, MR. C. OCKRENT, MR. H. G. ROLFE and MR. G. F. WILLIAMS joined the board of British Drug Houses, Ltd., on January 1.

Dr. D. C. Martin, formerly general secretary of the Chemical Society, who took up his duties as assistant secretary to the Royal Society this week.

The following have been appointed executive directors of Colvilles, Ltd.: MR. W. BARR, chief metallurgist; MR. R. C. DYMOCK, chief labour officer; MR. T. W. HAND, chief mechanical engineer; MR. J. MCCRACKEN, senior works manager; MR. R. MARSHALL, sales manager; MR. L. ROTHERA, chief electrical engineer, and MR. T. J. SMITH, purchasing manager.

PROFESSOR T. DAVID JONES, head of the Mining Department of the University College of South Wales and Monmouthshire, has been appointed to the Chair of Coal and Metalliferous Mining at Birmingham University. Since the death of Professor K. N. Moss, the department has been in charge of Professor Stacy Ward, who is now second Professor in Chemical Engineering.

Honorary degrees will be conferred by the Court of Leeds University at a Congregation in May as follows: Doctor of Laws, MR. C. F. R. BROTHERTON (the well-known Yorkshire chemical manufacturer and benefactor of Leeds University); Doctor of Science. PROFESSOR M. POLYANI (Professor of Physical Chemistry at Manchester University); and MR. C. M. WHITAKER (president of the Society of Dyers and Colourists).

New Year Honours

Names of particular interest to the chemical and allied industries appeared in the New Year Honours List, which was published as we were going to press.

Among those honoured with the title of Knight Bachelor are: MR. WILLIAM HENRY COATES, a deputy chairman of I.C.I., Ltd.; PROFESSOR WALTER NORMAN HAWORTH, Mason Professor of Chemistry and Director of the Department of Chemistry at Birmingham University; and MR. ERNEST WOODHOUSE SMITH, lately president of the Institute of Fuel.

SIR FREDERICK JOSEPH WEST, chairman and managing director of West's Gas Improvement Co., Ltd., receives the G.B.E.

Recipients of the O.B.E. include: MR. G. E. BAIRSTOW, senior principal scientific officer, Ministry of Supply; MR. J. W. GIBB, director of the Alkali Division of I.C.I.; MR. L. B. PFEIL, manager of the research and development department of the Mond Nickel Co., Ltd.; and DR. D. D. PRATT, Ph.D., assistant director of the Department of Scientific and Industrial Research.

Obituary

MR. WILLIAM BOYD QUIBELL, a member of the Newark firm of Quibell Bros., Ltd., and later a director of British Glues & Chemicals, Ltd., Newark, has died at the age of 79.

NEW BENN BOOKS

The following books are among the interesting new publications by Ernest Benn Ltd., Bouverie House, Fleet Street, E.C.4.

"Short Stories of H. G. Wells," a 1150-page "omnibus" containing 63 stories, 15s.

"Ploughman of the Moon," by Robert W. Service, a second large impression of the autobiography of the "Kipling of Canada." 15s.

"Institutional Catering," by D. Grainger and W. H. Turpin, a new revised edition. 3s. 6d.

"The Story of the Amulet," by E. Nesbit. One of the famous series of children's books. 6s.

"Songs of a Sourdough," Robert W. Service's first and perhaps most popular book of verse, including "The Spell of the Yukon." 6s.

"Palestine," by Professor Norman Bentwich. A new edition of an important volume in the Modern World Series, with a prologue bringing the story of Palestine up to October 1946. 12s. 6d.

Home News Items

The official cost-of-living index figure at November 30 last was 104 points above the level of July, 1914, as compared with 103 points at November 1. The rise in the figure was due to the increases in the price of gas in certain areas.

Development of Leven as a major British centre for chemical enginering production is at present being retarded by shortage of houses, according to Mr. Lindsay Burns, managing director of Henry Balfour & Co., Ltd. He was pleading to the local council for houses for key workers who were to be brought in to assist in the development of the firm's plant, which already has about 1200 employees.

The selling price of molasses for all purposes other than cattle feed has been increased to cover the current average cost of supplies. This involves a considerable increase in the production costs of industrial alcohol and solvents derived therefrom and a new Order—S.R. & O., 1946, No. 2195—has accordingly been issued, revising the existing maximum selling prices prescribed for these commodities.

Amendment lists to D.T.D. Specifications have recently been issued as follows: Amendment List No. 3 to Specification No. 304, "Aluminium Alloy Sand or Die Castings;" Amendment List No. 2 to Specification No. 683, "Aluminium Alloy Bars, Extended Sections and Forgings;" Amendment List No. 1 to Specification No. 910B, "Processes for the Anodic Oxidation of Aluminium and Aluminium Alloy Parts." Copies are obtainable from H.M. Stationery Office (1d. each).

The establishment of a British Commonwealth Scientific Office in London, as a permanent means of facilitating scientific collaboration between the countries of the Commonwealth, is the principal recommendation embodied in the report just issued (H.M. Stationery Office, Kingsway, London, W.C 2, 1s. 3d.) of the British Commonwealth Scientific Official Conference. This conference followed the Royal Society's Empire Scientific Conference last July and was primarily concerned with discussing the scientific collaboration which developed within the Commonwealth during the war and devising measures by which it might be maintained and improved. Most of the resolutions—which will be considered by the Governments of the United Kingdom, the Dominions and India—are of an administrative rather than immediate scientific interest.

Production of colloidal gold was an experiment demonstrated to senior pupils of Edinburgh schools at a vocational lecture on metals given, under the auspices of the Royal Institute of Chemistry, Scottish Section, by Dr. James Sandilands, senior lecturer in chemistry at the College.

Extended facilities for advanced research work, including accommodation for research in nuclear physics, are provided for in proposals by Cambridge University to develop laboratories on a 200-acre estate across the borough boundary on the Barton Road. This follows the decision to group the laboratories of the chemical department (inorganic, organic, physical chemistry and metallurgy) on a site fronting Lensfield Road, which will give the department urgently needed facilities and also enable the Cavendish Laboratory to be enlarged.

The number of people employed in industry has increased substantially since 1939, according to recent Ministry of Labour returns. Those engaged in the manufacture of metals and chemicals for the home market in October, 1946, totalled 2,495,000, as compared with 1,586,000 in mid-1939; and those engaged similarly for the export market totalled 908,000, as compared with 450,000. The term "metals and chemicals" includes metal manufacture, merchant shipbuilding and ship repairing, engineering, aircraft, motors and other vehicles, metal goods, chemicals and explosives.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

INSULOID MANUFACTURING CO. LTD. Stockport, manufacturers of insulatin plastic &c. (M., 4/1/47.) December 2, 1946, mortgage to Midland Bank Ltd., securing all moneys due or to become due to the Bank, charged on 2/4 Mulberry St., Hulme, Manchester, with machinery, fixtures &c. *——, May 1, 1946.

Overseas News Items

Nitrate companies operating in Chile report appreciable increases in net earnings.

A chemical fertiliser industry is to be established in Bulgaria.

Erection of a cement plant near Kingston, Jamaica, by a British concern has been indefinitely postponed pending legislative action.

To exploit extensive asbestos occurrences in Catalonia, a new company has recently been formed which intends to erect four plants.

Bauxite deposits have been found in a number of places in Tasmania, certain of which are being tested to determine the reserves of ore suitable for the production of aluminium.

Some 800 Italian firms are now engaged in the various plastics industries, as against about half that number in 1939. However, the lack of coal is at present a handicap to the industry.

French glass production is most advanced in the sheet glass section which remains steady at 240 per cent of the 1938 figures, but the production of other glassware has also improved and has now reached the pre-war level.

The Swedish chemical-technical industry had 971 plants operating in 1944, according to statistics in *Kommersiella Meddelenden*. Charcoal and wood-distillation plants numbered 444; there were 108 factories making cleansing compounds, perfumes and candles; and 47 compressed-gas factories.

New plant of Standard Chemical Company at Longford, Ontario, is nearing completion and will be used for the manufacture of carboxy methyl cellulose in several modifications to meet specific trade requirements. Extensive research has been carried out and a company representative was in Europe for several months studying production methods and industrial applications.

World linseed production has been estimated for 1946 at 141,800,000 bushels by the U.S. Department of Agriculture. This advance on the September estimate is due to increased estimates of the South American crops and puts production 7 per cent above the previous year and 4 per cent above the 1935-39 average. The Department stated that the high prices are expected to encourage larger linseed plantings in 1947 compared with the averages for the period 1944-46.

The number of chemical doctorates granted in American universities in 1945 was only 324, as compared with 672 in 1941.

Destroyed during the war, the rayon factory at Zydowin, near Szczecin, Poland, is nearing reconstruction, states the Polish press.

A deposit of calcite, estimated at more than 5,000,000 kg., has, according to an American report, been discovered at Matauna, in the State of Goiás, Brazil.

German scientists are to be invited to Australia, it is announced by the Australian Premier. They must have qualifications not possessed by Australians and would be "lent" to State authorities or private firms.

Production of salt in Mexico for the year ending July 31 last amounted to 177,233 metric tons. Methods are described as primitive; approximately 60 per cent of the total output is sea salt, the remainder coming from brine deposits.

Iceland's imports of chemicals, chemical compounds and drugs in the first six months of 1946 amounted to 2,380,270 crowns in value. The United States supplied goods to a value of 906,013 crowns, followed by the United Kingdom, with 565,132 crowns' worth.

A two-way traffic in chemical products is forseen under the trade agreement signed recently in Stockholm between Sweden and Belgium/Luxembourg. Sweden will also export zinc and lead ores and machinery, while Belgium/Luxembourg will ship coke, iron and steel products and other industrial goods.

Drilling for oil at the Danish island of Mors, Limfjord, has resulted in the country's first petroleum discovery and the deposits are now being examined to ascertain whether they are of sufficient importance to engage in further drilling operations, reports the *Petroleum Press Service*. A search for oil is also proceeding on the islands of Seeland, Fyn, Lolland-Falster and Bornholm.

A new process for extracting sodium salts has been developed at Lonar Lake in the Buldana district of the Central Provinces, India, which is a rich source of sodium salts. Solid encrustations materialising on the lake in summer provide the raw material, it is recorded, and recovery is by a process which exploits the wide variations with temperature in the relative solubility of sodium chloride and sodium carbonate.

Company News

The nominal capital of **Chema Manufacturing Co., Ltd.**, chemical manufacturers, etc., Kingsway, Team Valley Trading Estate, Gateshead, has been increased, beyond the registered capital of £4000, by £28,000, in £1 ordinary shares.

A net profit of £40,291, as compared with £43,845 in 1945, is reported by **William Briggs and Sons, Ltd.**, for the year ended September 30, 1946. A final ordinary dividend of 25 per cent (as compared with 20 per cent last year) is recommended, making 35 per cent for the year.

New Companies Registered

Ajax Chemical Co., Ltd. (425,636).—Private company. Capital £2000 in 2000 shares of £1 each. Subscribers: S. Freeman; A. Lazarus. Registered office: 30 Redbourne Avenue, Finchley, London, N.3.

Progressive Chemicals Ltd. (426,181).—Private company. Capital £100 in 100 shares of £1 each. Subscribers: Mrs. E. Ridgway; Miss Kochmann. Registered Office: 5, Cecil Court, Holywood Road, London, S.W.10.

L. Hayward Ltd. (426,165).—Private company. Capital £1000 in 1000 shares of £1 each. Chemical engineers, etc. Directors: L. Hayward; P. Viall. Registered Office: 5, Boscastle Road, London, N.W.5.

Thomas Parsons, Ltd. (425,596).—Private company. Capital £500 in £1 shares. Manufacturers of and dealers in chemicals, gases, etc. Directors: J. Klugman; L. Parsons; A. Cardew. Registered office: 10 Ashley Place, London, S.W.1.

Lamoure Ltd. (424,555).—Private company. Capital £100 in £1 shares. Manufacturers and preparers of oils and oleaginous substances, etc. Directors: E. Bernasconi; H. Jones. Registered office: 8, St. George Street, Hanover Square, London, W.1.

Klimco Ltd. (425,176).—Private company. Capital £1000 in 1000 shares of £1 each. Manufacturers of and dealers in chemicals, dyes, paints, etc. Subscribers: R. Freeman; A. Shepherd. Solicitors: Dabonic, Freeman and Co., 49, Queen Victoria Street, London, E.C.4.

Lindale Products, Ltd. (425,823).—Private company. Capital £100 in £1 shares. Manufacturers of and dealers in oils, greases, oleaginous and saponaceous substances and chemicals, etc. Directors: J. Linchis; H. Linchis. Registered office: Goldsmith House, 137, Regent Street, London, W.1.

Mesh Fabrics, Ltd. (11,711).—Private company. Capital £2500 in 2500 shares of £1 each. Manufacturers of and dealers in plastics, glass, chemical and scientific goods, etc. Subscribers: M. Murphy; J. Healy. Secretary: C. A. Sheppard, 14, Westmorland Street, Dublin.

Armex, Ltd. (425,917).—Private company. Capital £1000 in £1 shares. Brokers, import and export agents, dealers in animal raw products, skins, leather, oils, fats, and all chemical products, etc. Subscribers: B. Mayer; G. Hawkes. Registered office: 55-61, Moorgate, London, E.C.2.

Ernest I. Lee (Export) Ltd. (426,027).—Private company. Capital £500 in 500 shares of £1 each. Manufacturers, etc., of chemicals, drugs, disinfectants, fertilisers, oils, colours, glues, etc. Subscribers: E. Lee; L. Evans. Registered office: 349, Park Road, Liverpool, 8.

Northern Industrial & Scientific Equipment Co., Ltd. (424,810).—Private company. Capital £100 in 100 shares of £1 each. Dealers in scientific and industrial equipment for chemical and industrial plant, etc. Directors: N. Redmond; J. Halpern. Registered office: 41, Store Street, Manchester.

Jesse Boulton, Ltd. (424,790).—Private company. Capital £2500 in £1 shares. Wholesale, retail and manufacturing chemists; chemical engineers, makers of chemical plant, etc. Directors: T. Gilmour, M.P.S., and F. Gilmour. Registered office: 25, Guildhall Street, Folkestone.

Basildon Products, Ltd. (425,361).—Private company. Capital £100 in 100 shares of £1 each. Manufacturers of and dealers in metals, plastics, chemicals, etc. Subscribers: G. Conrad; E. Harvey. Registered office: 24/5, Manchester Square, London, W.1.

Plas-Paint, Ltd. (425,192).—Private company. Capital £10,000 in 40,000 shares of 5s. To acquire patents relating to the manufacture of chemical, industrial, synthetic and other preparations, paints, etc. Directors: D. Markham;; Lord R. Graham. Registered office: 35, New Broad Street, London, E.C.2.

Petrocarbon Developments, Ltd. (426,075).—Private company. Capital £100 in 100 shares of £1 each. Manufacturers, importers, and exporters of and dealers in crude oil, petroleum products and chemicals derived therefrom, coal products, etc. Subscribers: C. Garrett; M. Wordley. Registered office: River Plate House, South Place, London, E.C.2.

Chemical and Allied Stocks and Shares

BUYING interest in stock markets has again centred on industrial shares, although British Funds were firm and home rails again strengthened. Sentiment in regard to the nationalisation groups appeared

to be helped by the dividend payment made by Cable & Wireless a few hours prior to acquisition of the undertaking by the Government. It is being generally assumed that E.P.T. is unlikely to be replaced by any new device for limiting dividend payments. It is realised, however, that cash benefits arising from E.P.T. abolition will have to be placed to plant and other reserves. On the other hand, there is a growing belief that, particularly in the case of companies playing an important part in export trade, higher distributions to shareholders are likely. One company which raised its distribution this week announced part of the increase as an "export bonus."

Imperial Chemical continued in demand and rose further to 45s. 7½d. in response to indications of steady expansion of business in home and overseas markets. B. Laporte remained firm at 103s., and Fisons were little changed at 64s. 9d., while W. J. Bush ordinary shares continued tightly held and quoted at 90s. Greeff-Chemicals Holdings 5s. ordinary were 13s. 3d., and Burt Boulton around 27s. There was again buying of British Drug Houses shares, which rose further to 65s., the company being among those which can expect to be large beneficiaries from the abolition of E.P.T. Stevenson & Howell 5s. ordinary were dealt in around 31s., and Monsanto Chemicals 5½ per cent preference marked 23s. On the other hand, Turner & Newall eased to 87s. 9d., but Borax Consolidated deferred at 48s. 6d. were fortified by market hopes of a higher dividend. British Aluminium (45s. 9d.) were firm on reports of record demand for the metal. British Match 54s. and British Oxygen 101s. 10½d. have been well maintained. General Refractories were favoured up to 23s. 6d.

Textile shares eased on the fuel situation, but there was further buying of iron and steels, yields on the latter being attractive in most instances. Guest Keen showed a fresh rise to 49s. 7½d., South Durham Steel were 28s. 6d. and United Steel 28s., while Whitehead Iron rose to 106s. 9d. Allied Ironfounders at 64s. 6d. and Babcock & Wilcox 70s. 9d. were also higher, while Dorman Long were 28s. and T. W. Ward 50s. 9d. Powell Duffryn eased to 26s. 4½d., but Staveley were 54s. 9d., and Shipley Colliery 43s. 9d. colliery shares generally showing firmness. Amalgamated Metal strengthened to 21s. 7½d.

In other directions, United Molasses have been favoured up to 56s. 6d. Lever & Unilever were also higher at 53s., as were Dunlop Rubber at 74s. 6d. Barry & Staines at 59s. 6d. moved higher, while awaiting the dividend announcement, Nairn & Greenwich have been firm at 85s. and Wall Paper Manufacturers deferred moved higher at 49s. There was renewed buying of paint shares, Lewis Berger being £8 3/16, British Paints Holdings 61s. 3d., and International Paint £7½. Among plastics, movements were small with De La Rue £13⅞, and British Industrial Plastics 2s. ordinary were 8s. The units of the Distillers company eased, but later rallied to 138s. 9d.xd. British Glues & Chemicals 4s. ordinary showed firmness at 17s. 9d., with the participating preference at 48s. 6d., and elsewhere, Blythe Colour 4s. ordinary shares have been firm at 50s.

Boots Drug eased to 63s. 6d., Beechams deferred were 28s. 3d., Sangers strengthened to 34s. 9d., and Timothy Whites were 49s. 6d. Oil shares claimed increased attention under the lead of Anglo-Iranian, which at £5 15/16 have gained nearly 15s. since the news of the important agreement proposed with leading U.S. oil companies which are increasing their interests in the Middle East. Burmah Oil shares also rose strongly, this company (after the British Government) being the largest shareholder in Anglo-Iranian Oil. Shell and Trinidad Leaseholds were also higher.

British Chemical Prices

Market Reports

WITH the influence of the holiday period receding, the London industrial chemical market has quickly returned to normal activity and deliveries are being called for in good quantities. The demand both for home and export account is reported to be on a good scale. Several price changes are expected to be announced during the next few weeks. As from January 1 the controlled prices for acetone are increased by £20 per ton; acetic acid (glacial) is higher by £11 per ton, and acetic acid 80 per cent higher by £9 per ton. Formic acid is unchanged, but an increase in quotations for formaldehyde is expected. In other directions the undertone is very firm. The coal-tar products market remains steady.

MANCHESTER.—The Manchester market for both light and heavy chemical products has made a rather quiet resumption after the holidays so far as actual new bookings are concerned, though there has been renewed pressure for deliveries of materials already on order. Coal supply difficulties are a threat to operations in the textile mills and any serious interference with work there would inevitably have an adverse effect on the consumption of chemicals in the bleaching, dyeing and finishing trades. Fuel problems are also being faced by the chemical-manufacturing industry itself. The undertone of the market in all directions remains distinctly firm. One or two sections of the fertiliser market are fairly active, and in the tar products market a steady call for deliveries of most materials is reported.

Inventions in the Chemical Industry

The following information is prepared from the Official Patents Journal. Printed copies of specifications accepted may be obtained from the Patent Office, Southampton Buildings, London, W.C.2., at 1s. each. Numbers given under "Applications for Patents" are for reference in all correspondence up to acceptance of the complete specification

Applications for Patents

Alcohol.—C. Arnold. (Standard Oil Development Co.) 35714-5.

Hydrocarbons.—C. Arnold. (Standard Oil Development Co.) 35716.

Thermoplastic materials.—Ashdowns, Ltd., and C. B. Joseph. 35359.

Gravity feed devices, etc.—F. C. Ashen, and I.C.I., Ltd. 35429.

Treatment of fish roes.—M. A. E. Assada. 35086.

Extraction of nucleic acid.—M. A. E. Assada. 35087.

Catalysts.—Baker & Co., Inc. 35470.

Extraction of fat and water from bones.—R. G. Bluementhal. 35068.

Diketones.—J. G .M. Bremner, D. G. Jones, and I.C.I., Ltd. 35434.

Carbazole derivatives.—British Thomson-Houston Co., Ltd. 35052.

N-vinyl carbazole.—British Thomson-Houston Co., Ltd. 35224.

Silicone compositions.—British Thomson-Houston Co., Ltd. 35492.

Piezoelectric crystals.—Brush Development Co. 35302.

Polymeric ureas.—G. D. Buckley, N. H. Ray, and I.C.I., Ltd. 35430.

Ureas.—G. D. Buckley, N. H. Ray, and I.C.I., Ltd. 35431.

Catamenial tampons.—A. F. Burgess. (International Cellucotton Products Co.) 35041.

Moulding of plastic materials.—E. A. Chapuis. 35561-2.

Dissipating static charges from bodies.—G. R. S. Charles, W. T. Sanderson, and M. H. Easy. 35085.

Adhesives.—Colmore Adhesives, Ltd., and R. N. Haward. 35021.

Laminated glass.—Colmore Adhesives, Ltd. 35022-3.

Alloys.—J. D. Cooper. 35696.

Aromatic hydrocarbons.—E.I. Du Pont de Nemours & Co. 35146.

Carboxylic acids.—E.I. Du Pont de Nemours & Co. 35436.

Stabilisation of furan.—E.I. Du Pont de Nemours & Co., and H. B. Copelin. 35145.

Mineral oil compositions.—C. E. Every. (Vacuum Oil Co. Proprietary, Ltd.) 35503.

Alkylated phenols.—Firestone Fire & Rubber Co. 35160.

Uniting of metals.—General Electric Co., Ltd., and J. F. Smith. 35476.

Cellulose esters.—N.V. Gevaert Photo-Producten. 35216.

Carboxylic acids.—W. W. Groves. (Ciba, Ltd.) 35468.

Sulphuric acid mixtures.—N. J. Hassid. 35373.

Forming a layer of copper on copper oxide.—P. Hersch. 35548.

Regulation of viscosity in liquids.—K. T. Kalle. 35240.

Resinous products.—F. H. Levey, Inc. 35671.

Treatment of metal surfaces.—Monochrome, Ltd., and H. C. Hall. 35301.

Carbon black.—Phillips Petroleum Co.—35156.

Cellulosic composition.—Plaswood Corporation. 35203.

Pyrimidine derivatives.—G. R. Ramage, and I.C.I., Ltd. 35143.

Diacetylenic diamines.—J. D. Rose, B. C. L. Weeden, and I.C.I., Ltd. 35144.

Liquid fuel atomisers.—E. P. Sharp, and S. C. Morrel. 35493.

Thermoplastic materials.—Telegraph Construction & Maintenance Co., Ltd., H. F. Wilson, and D. E. Partington. 35719.

Organic nitrogen compounds.—W. Tyerman, and I.C.I., Ltd. 35428.

Separation of organic nitrogen compounds.—W. Tyerman, and I.C.I., Ltd. 35432-3.

Olefinic compounds.—United States Rubber Co. 35422.

Complete Specifications Open to Public Inspection

Manufacture of 7-dehydrosterol.—N.V. Philips' Gloeilampenfabrieken. Jan. 28, 1943. 31490-1/46.

Methods of hardening alloys.—N.V. Philips' Gloeilampenfabrieken. Feb. 27, 1943. 31918/46.

Treating carbon articles.—National Carbon Co., Inc. May 22, 1945. 12593/46.

Process and device for vegetable cells (and of the cellulosic walls of said cells) as in cereals, cereal waste products and the like.—C. Sander. June 3, 1942. 31671/46.

Catalytic oxidation of ketones.—Shell Development C. Nov. 27, 1942. 4867/44.

Latex, process for the manufacture of the same and applications thereof.—Soc. Meridionale du Caoutchouc Someca. May 22, 1945. 13837/46.

Production of solid depolarisation bodies from active carbon for atmospheric oxygen elements.—Spolek Pro Chemickou a Hutni Vyrobu, Narodni Podnik. Feb. 20, 1943. 32380/46.

Production of unsaturated hydrocarbon products from petroleum refining residues.—Wilmington Chemical Corporation. July 22, 1943. 14016/44.

Alkyl esters of nicotinic acid.—Winthrop Chemical Co., Inc. May 22, 1945. 13893/46

Heavy-media separation apparatus.—American Cyanamid Co. June 1, 1945. 13063-13066/46.

Carborundum containing saggars for the firing of ceramic articles.—S. A. E. Berg. May 29, 1945. 16182-3/46.

Removal of ultimate moisture from powdered products.—Borden Co. June 2, 1945. 14014/46.

Composition of matter.—Crane Packing Co. May 31, 1945. 8762/46.

Production of alkali metals or alloys thereof.—E.I. Du Pont de Nemours & Co. Aug. 18, 1943. 15834/44.

Production of vinyl cyanide.—E.I. Du Pont de Nemours & Co. May 30, 1945. 16326-7/46.

Production of saturated chlorohydro-carbons.—E.I. Du Pont de Nemours & Co. May 30, 1945. 16328/46.

Protection of steel against corrosion.—Indium Corporation of America.—May 30, 1945. 15926/46.

Producing preservatives.—Institute of Paper Chemistry. June 1, 1945. 15658/46.

Prisms and method of forming same.—International Polaroid Corporation. Dec. 31, 1943. 24543/44.

Treating low-grade fatty materials.—Lever Brothers & Unilever, Ltd. May 29, 1945. 16379/46.

Magnesium silicate and products thereof.—Marine Magnesium Products Corporation. May 29, 1945. 7761/46.

Process for obtaining chromium salts and chromic acid.—S. P. Mendicouague. June 2, 1945. 4291/46.

Method of nitriding.—Nitralloy Corporation. Nov. 5, 1943. 32730/46.

Esters and the preparation thereof.—Pittsburgh Plate Glass Co. April 14, 1943. 12968/44.

Manufacturing oils or oily products.—J. Rinse, and W. Dorst. Oct. 23, 1944. 33407-8/46.

Manufacture of an aneurin derivative.—Roche Products, Ltd. June 1, 1945. 15917/46.

Fluid catalyst catalytic cracking.—Shell Development Co. June 1, 1945. 14451/46.

Tank furnaces for the continuous manufacture of glass or vitreous materials.—Soc. Anon. des Manufactures des Glaces et Produits Chimiques de Saint-Gobain, Chauny & Cirey. May 24, 1945. 15880/45.

Production of a derivative of benzotetronic acid.—Spojene Farmaceuticke Zavody Narodni Podnik. March 18, 1944. 33022/46.

Conversion of saturated hydrocarbons into saturated hydrocarbons of more branched chain character.—Texaco Development Corporation. June 27, 1942. 11566/43.

Resinous composition.—Westinghouse Electric International Co. Sept. 20, 1944. 32684/46.

Bimetallic actuators.—H. A. Wilson Co. April 12, 1940. 33499/46.

Complete Specifications Accepted

Lubricating grease composition.—C. Arnold. (Standard Oil Development Co.) Oct. 12, 1943. 582,501.

Manufacture of aluminium soap lubricating greases.—C. Arnold. (Standard Oil Development Co.) Oct. 14, 1943. 582,502.

Catalytic processing of hydrocarbons.—J. C. Arnold. (Standard Oil Development Co.) Oct. 27, 1943. 582,629.

Parasitical preparations.—T. A. Clayton. (United States Rubber Co.) March 28, 1944. 582,665.

Concentration of aqueous dispersion of neoprenes.—E.I. Du Pont de Nemours & Co. and F. N. Wilder. Sept. 25, 1944. 582,700.

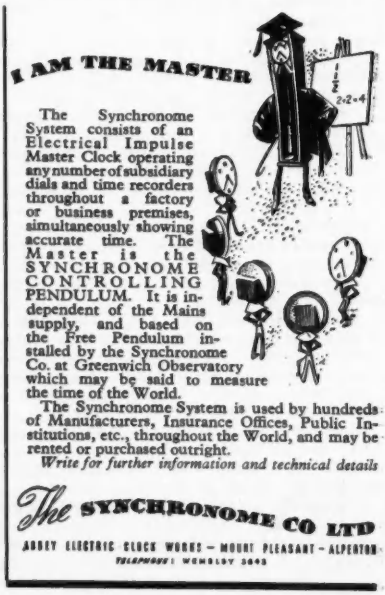
Cast synthetic resin articles.—W. E F. Gates, and I.C.I., Ltd. June 9, 1944. 582,559.

Anti-bacterial pyridine derivative and salts thereof.—Glaxo Laboratories, Ltd., E. M. Gibbs, and G. F. Penny. July 5, 1944. 582,638.

Manufacture of basic esters and basic amides of 1-phenyl-cycloakyl-1-carboxylic acids and the quaterrary ammonium compounds thereof.—W. W. Groves. (J. R. Geigy, A.G.) April 21, 1944. 582,535.

Propellant explosives.—D. H. Hall. June 15, 1942. 582,621.

Production or refining of aluminium.—High Duty Alloys, Ltd., and P. Gross. April 19, 1944. 582,579.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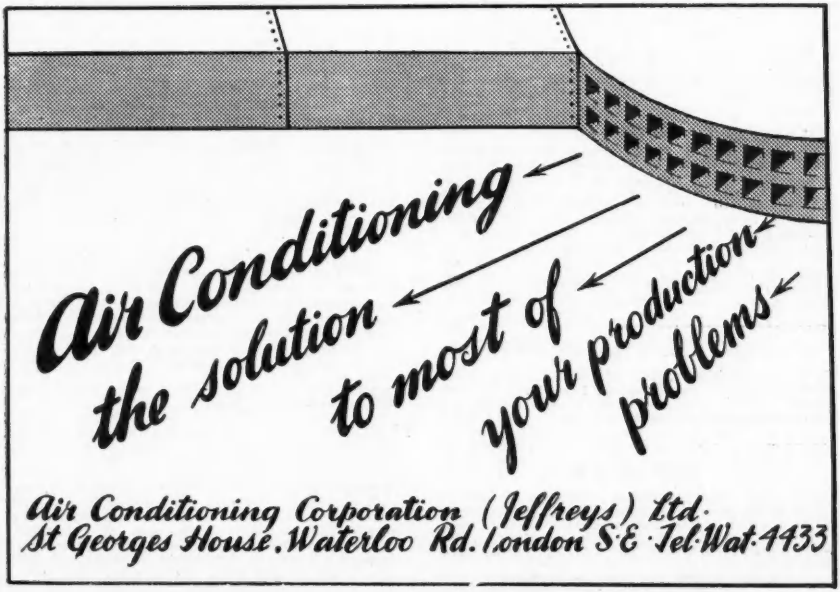

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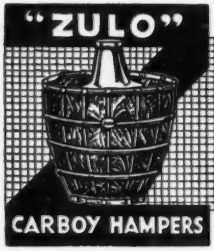

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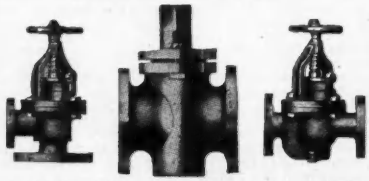

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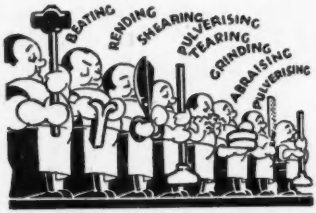

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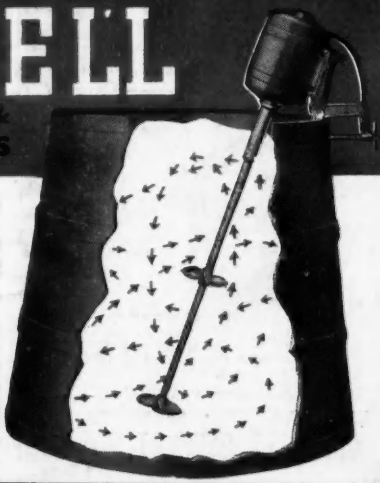

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